The Welding Engineer

Reg. U. S. Pat. Office

MENT OF ENGINEERING SHOP

th your comments
pass on

FROM

OSTON ✓
MPBELL ✓
AZDOWSKI
INDLER ✓
FER ✓
NAN
RKER

COMMENTS

31 2500

Steel in the Home—More Work for the Welder (*See Page 5*)

April
1932

PREMIER
TESTED
Welding Wire

Welds of Maximum Strength

You can be sure of maximum strength and satisfaction when you use Premier Tested Welding Wire—both electric and gas. No guesswork with this wire for each bundle is shop tested for uniformity—for perfect fusion—for impurities—for general efficiency before it gets into your hands. Thus, remarkable service records are the rewards of those who specify Premier. There's a type for every purpose and each length is plainly marked for grade. Write us about your welding problems—no obligation.

1831 MORE THAN 100 YEARS of PROGRESS in WIRE MAKING **1932**

AMERICAN STEEL & WIRE COMPANY

208 South LaSalle Street, Chicago — SUBSIDIARY OF UNITED STATES STEEL CORPORATION — And All Principal Cities

Pacific Coast Distributors. Columbia Steel Company, Russ Building, San Francisco — *Export Distributors:* United States Steel Products Company, New York

The Welding Engineer

With Which is Combined ACETYLENE JOURNAL

Volume 17 | April, 1932 | Number 4

THE WELDING ENGINEER
PUBLISHING CO.

608 S. Dearborn St., Chicago, Ill.

Telephone WEBster 7134

G. H. Mackenzie.....President and Treasurer
H. S. Card.....Secretary

H. S. Card.....Editor
M. S. Hendricks.....Managing Editor

Eastern Office—222 American Circle Bldg., New York. T. E. DePew, Eastern Manager. Telephone, Columbus 7843

AUTHORIZED REPRESENTATIVES

CLEVELAND, OHIO—R. K. Randall, 2261 E. 14th St.

DENVER, COLO.—A. G. Odell, Public Opportunity School.

GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London.

AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.

SOUTH AFRICA—J. W. Arnison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

Published on the 15th of each month. Subscription payable in advance and postage free. United States and possessions, $3 a year; Foreign Countries, $4 a year; Canada, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 30 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

Last advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

MEMBER AUDIT BUREAU OF CIRCULATIONS

AIBP

Table of Contents

THE MONTHLY SYMPOSIUM

Structural Welding 23
Non-Ferrous Metals 25
Maintenance Welding 26
Hard Surfacing 27

Modernizing for Profit 29

Steel in the Home 32

X-Ray Diffraction Patterns 35

Pulleys that Stay Put 39
By M. L. Eckman

Sheet Welding in Production 42
By Earl Kelsey

Methods of Controlling Arc Blow 44
By R. W. Holt

Building a Job Welding Business 49
By W. Irving Brockson

Editorial 21

The Ideal Application 34
By Paul B. Covey

Gas Welding in Transportation 36

Events and News of Interest 52

New Literature 53

New Products 54

News of the Industry 56

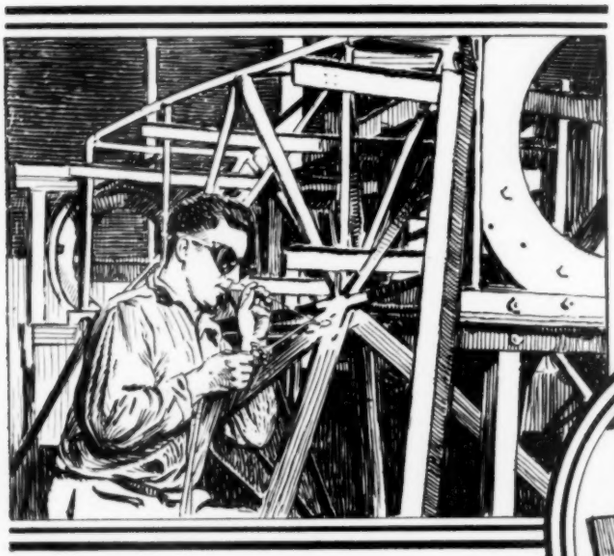
The Picture on the Cover.*

The far-reaching effects of the present drive toward the use of more steel in home building are only partially suggested in the article "Steel Frame Homes—More Work for the Welder," which starts on page 32. When some of today's plans are developed on a production basis there will be work for every welding process.

**Photo by Courtesy of The Lincoln Electric Co.*

From simple joints to complex designs

LINDE PROCESS SERVICE ASSURES DEPENDABLE WELDS



LINDE PROCESS SERVICE frequently suggests methods that mark the turning point from uncertain production costs and possible losses to certain profits.

Whether the problem is one of simple joining or intricate fabrication, Linde Process Service offers you, if you use Linde Oxygen, every facility for the most effective use of oxy-acetylene welding and cutting. This service, with its unequalled background of scientific research and practical experience, is readily coordinated with the work of your own engineers and welders in securing maximum speed, economy and dependability. For example:

It assisted a manufacturer of laundry equipment in obtaining ideal joints in sheet metal for vitreous enameling. The joints produced are strong enough to withstand the strains of the enameling process and so smooth as to become invisible.

It helped a chemical plant in developing corrosion resisting welds in aluminum pipe coils used in rosin manufacture.

It developed procedure controls for aircraft welding, including specialized training and severe qualification tests for the welders and careful inspection of every detail of the work.

These examples illustrate but a few of the many benefits Linde customers constantly receive from Linde Process Service. Consult the nearest Linde District Office for further facts showing how oxwelding and cutting under Linde Procedure Control can be of immediate benefit to you.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

126 Producing Plants UCC 627 Warehouse Stocks

IN CANADA, DOMINION OXYGEN COMPANY, LTD., TORONTO

District Offices

Atlanta	Detroit	New York
Baltimore	El Paso	Philadelphia
Birmingham	Houston	Pittsburgh
Boston	Indianapolis	St. Louis
Buffalo	Kansas City	Salt Lake City
Chicago	Los Angeles	San Francisco
Cleveland	Milwaukee	Seattle
Denver	Minneapolis	Tulsa

LINDE OXYGEN · PREST-O-LITE ACETYLENE · OXWELD APPARATUS AND SUPPLIES · UNION CARBIDE

EDITORIAL

Check Destructive Buying

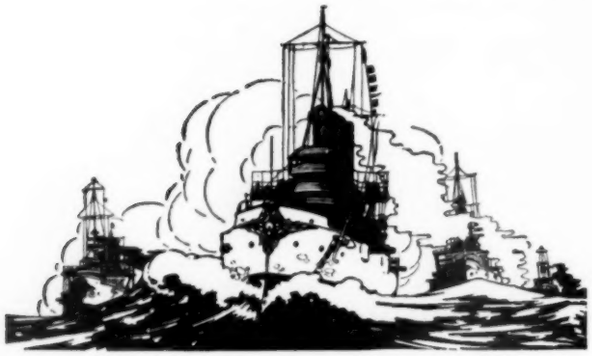
A NEW word has been creeping into the vocabulary of the salesman. The playing of one against the other by the buyer in order to force prices down to the lowest levels is being referred to as "chiseling." It is a practice which is producing such disastrous results in industry that some firms are taking drastic steps to eliminate it from their own purchasing departments, for no other reason except that business which is not done at a profit is not business. The sales executives undoubtedly paved the way themselves in times when markets were active, building reputations on volume at the sacrifice of profit. Now the buyers show a tendency to make a bad matter worse by insisting on still lower prices, and the results of their handiwork are seen in closed banks, bread lines, vacant homes and lowered security values. Buyers should be made to face these facts. The elimination of sales in which profits are sacrificed will go far toward completing the economic readjustment toward which all industry is working. In this country men certainly do not need to depend for their living upon the misfortunes of others. The man who is buying also has something to sell, and if destructive buying is to be the order of the day his sales force will have to submit to the same "chiseling" process. Purchasing agent and salesmen have a sound basis for cooperation. Every order placed by the former should be on a basis that a profit is made, and every sale made by the latter should guarantee a profit to the boss. Research work has done wonders for our industrial development up to date. It is promising still more. But to carry out the plan suggested by research requires capital and capital requires profit. All the forces at work to restore confidence and release funds for more operations and more employment will be unavailing as long as profitless buying and selling are allowed to continue.

The Buffalo Opportunity

LESS than six months remain before the opening of the National Metal Exposition at Buffalo. It really isn't a long time for making plans for an event which means so much to the metal working industries. The city is easily reached by men from all over the eastern and middle western states, the show is well organized in every respect, and the industrial world needs the education and the inspiration which the week will furnish. And since experience has shown that the welding processes are sure-fire attention getters on this occasion it is rather up to the welding industry to see that its share of the opportunity is realized. Why not make it a new kind of a show as far as this industry is concerned? Dispense with some of the conventional and time-honored practices and put on some modern touches, possibly spending a little less money and getting a little more in the way of results. If the making of plans is put off until the week before the exposition opens, a good deal of disappointment is the most probable result. Start now. Let the memory drift back to the things that have been done over and over so many times that they no longer get attention even for good things. Cross them off the list. Then put the imagination to work on some new ideas, ideas that will get people out of the aisles and into the booths. Work out the ideas early and keep at work perfecting details until the last minute. Make it pay.

Modernizing the Job Welding Shop

AS an illustration of the real pressing need for the job shop operator to keep everlastingly on the lookout for new customers and new fields of service, take these remarks from one of them, "The progress of the welding industry will drive the job shop out of business if it does not find new work to do. Right now our shop is working on two jobs which pay good money, but both of them are jobs that are rapidly disappearing. One of these is a boiler repair. It is a riveted boiler. Just one defective rivet in a boiler can start trouble which will develop into a fine repair bill, and we have spent years in building up a reputation for ability to fix a riveted boiler so it will stay fixed. The trouble is that builders are buying more and more welded boilers, and welded boilers just don't seem to need fixing. Our other job is the repair of a large storage tank which has been leaking around several screwed fittings. We used to get a lot of this work, but now we get it only on very old tanks. Tank manufacturers are welding on fittings as well as welding the seams, because buyers have found out that this kind of a tank needs no repairs after it is once installed, and it seems to me that every one of these welded fittings means a job that the job shop will not get." Surely this would be a gloomy picture if the average shop had no new opportunities before it. But the progressive shop owner knows that modern trends are in reality opening up new and more profitable fields for him. He knows that there are many things he can fabricate and sell at a good profit before some bigger plant can develop mass production methods of making them at much lower costs. He can also do a great variety of production jobs cheaper and better than his customers can do them in their own plants. The very fact that he depends upon welding for his living causes him to investigate every new development, every new material, and every new process—and look for a market for it. There are no policies, standards, capital investments or conservative department heads to keep him from cashing in on every new idea, nobody to be "sold," nothing to do but go ahead. If any "old-timer" thinks differently, let him investigate the kind of work that the busiest shops are doing today, then investigate the kind of work done by some of the newer ones who are starting in with visions of only the present fields of service, and compare these with the range of work of five years ago. The answer will be that times have changed —for the better.



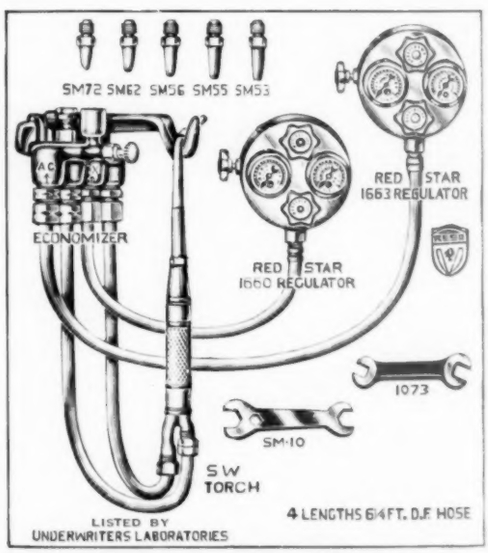
In the Battle *for* NEW Business

modern methods are as essential to success as in warfare. Just recently, Germany, limited to 10,000-ton armoured ships by the Versailles treaty, launched the "Admiral von Spee," a 9,000-ton ship with all-welded one-piece hull. Not only did welding save 1000 tons of weight as against riveted construction, but permitted the use of eleven inch guns, which would have forced the plates and sheared the rivets of a riveted hull. In addition, the saving in weight increased the speed and the cruising radius to a point where, although within treaty limits, this welded ship is far above its class in effectiveness.
So, too, in the battle for new business, new markets, new products

REGO Mass Production Welding Methods

provide the means of doing many operations better, quicker and cheaper. Excess material or weight is saved, production or assembling operations are speeded up, joints are as strong and as leak-proof as the metal itself. And remember—gas welds better—any metal, anywhere, anytime. Non-ferrous metals, as well as iron and steel, are joined in a way that permits machining and finishing. The weld is as flexible and as ductile as the parent metal itself.

Rego Factory Trained Sales Engineers are available for consultation on any production problems which might conceivably be solved by oxy-acetylene welding. Write us fully, describing the difficulties that confront you.



Rego High Speed Welding Outfit

Especially adapted for duplicate welding operations requiring intermittent use of torch. The Rego Economizer saves gases between operations and eliminates time lost in adjusting flame. Unit costs of production are reduced greatly, ranging as much as 60 per cent in some cases.

THE BASTIAN - BLESSING CO.

246 East Ontario St. :: :: :: Chicago, Illinois

THE MONTHLY SYMPOSIUM

Structural Welding

Drawbridge Repair

Through excessive strains and long years of heavy use, the huge single-span drawbridge of the Union Pacific Railway Co., which spans the ship channel to the Long Beach (Calif.) Harbor, developed an unsafe condition which necessitated reinforcing of the main rockers to afford smoother functioning and prevent further damage to the bridge.

View of Main Drawbridge Rocker Which Was Reinforced by Welding.

The National Electric Welding Corp., of Huntington Park, Cal., was awarded the contract to do this work by the electric arc process.

A view of one of the main rockers which supports and handles the raising and lowering of the bridge is shown herewith, and is one of the rockers on which a great deal of the reinforcing welding was done. Heavy mill plate reinforcing ribs can be seen which are welded solidly to the plate of the rocker on the far side, and welded intermittently on the near side. (See arrows pointing to the welds on one of the ribs.) Heavy welds about four inches long and about the same distance apart were made, two and three passes being made to complete each weld.

Another part of the job of reinforcing this bridge included the welding of a heavy bead along the base of the rocker where the old rivets had failed. (See arrow indicating this feature.) Intermittent welding was considered sufficient in this instance.

Three-sixteenth-inch Roebling welding rod was used in this work, which required about three weeks to complete. An inestimable saving was realized in this repair job, as otherwise the huge bridge would doubtless have had to be partly disassembled for the necessary repairs and reinforcing, all of which would have been a very expensive job, and would have tied up traffic and prevented use of the bridge for months. The successful completion of this job impressively demonstrates the remarkable savings in the application of arc welding to the repair of existing structures.

Field Welding Data

By Frank P. McKibbent

An interesting comparison may be made in the field-welding requirements of the Edison Electric Illuminating Company's building in Boston and the DuPont Company's structure in Wilmington. Although both are fourteen stories high, the latter is actually higher in feet, 194 feet as compared with 187 feet; has a total steel tonnage of 1576 versus 1314; and its ground area is also greater.

The elements which may be compared are; linear inches of fillets per ton of steel in building, Boston 46.05; Wilmington 41.5; total linear inches of fillets in each structure, Boston 60514, Wilmington 65400; time consumed by welders, man-hours per ton of steel in building, Boston, 0.917, Wilmington 0.895; electric current consumed per ton steel in building, Boston 4.66 K.W.H., Wilmington 5.33 K.W.H.; electrode melted and wasted per ton of steel in building, Boston 1.98 lb., Wilmington 2.04 lb.

Very close agreement in these respective figures are apparent. But it is desirable to point out the essential differences in the two structures which affect the amount of welding. For certainly, it cannot always be assumed that the several units vary in proportion to the steel tonnages. That assumption may be made with accuracy only when the structures are similar to an unusual degree. One would not expect to find the same amount of field welding in a mill building of 1000 tons of steel that would be necessary in a multi-story office building with an equal tonnage. But if the two buildings are similar except for the number of tons of steel in each, then welding units should be in fair harmony with these tonnages. But although the two projects under discussion are similar in some respects, nevertheless marked differences characterize each.

†*Consulting engineer, Black Gap, Pa.*

Comparative Field Welding Data, Fourteen-Story Office Building, Edison Electric Illuminating Company, Boston, Mass., and Fourteen Story Office Building of the DuPont Company, Wilmington, Del.

ITEM	BOSTON BUILDING	WILMINGTON BUILDING
Electrode melted and wasted ⅜ in.—1500 lb. ⅝ in.—1100 lb.	2600 lb.	3220 lb.
Electrode melted (assumed 80% of total)	2080 lb.	
Current used	6120 KWH.	8395 KWH.
Total tonnage of structural steel in building	1314 tons	1576 tons
Structural steel welded	1050 tons	
Actual hours of welders' time (man-hours)	1205½ hr.	1411 hr.
Total length of ⅜ in. fillets (in lin. in.)	51921	65400
Total length of ½ in. fillets (in lin. in.)	7188	
Total length of ⅝ in. fillets (in lin. in.)	1405	
Total length of all fillets (in lin. in)	60514	65400
Fillet per ton of steel in building	46.05 in.	41.5 in.
Fillet per ton of steel welded	57.63 in.	
Fillet deposited per welding man-hour	50.2 in.	46.4 in.
Fillet deposited per man per 8 hour day	33 ft. 6 in.	30 ft. 11 in.
Fillet deposited per pound of electrode melted and wasted	23.27 in.	20.3 in.
Fillet deposited per pound of electrode melted	29.09 in.	
Fillet deposited per K. W. H.	9.9 in.	7.78 in.
Electrode melted per K. W. H.	0.34 lb.	
Electrode melted and wasted per K. W. H.		0.384 lb.
Current required to melt one pound of electrode	2.94 KWH.	
Current required per lb. of electrode melted and wasted		2.61 KWH.
Welding man hours per ton of steel in building	.917 hr.	0.985 hr.
Welding man-hours per ton of steel welded	1.148 hr.	
Electrode melted per ton of steel in building	1.582 lb.	
Electrode melted per ton of steel welded	1.98 lb.	
Electrode melted and wasted per ton of steel in building	1.98 lb.	2.04 lb.
Electrode melted and wasted per ton of steel welded	2.48 lb.	
Electrode melted and wasted per hour per welder	2.16 lb.	2.28 lb.
Electrode melted and wasted per linear inch of fillet	0.043 lb.	0.049 lb.
Electrode melted per linear inch of fillet	0.0343 lb.	
Current required per ton of steel in building	4.66 KWH.	5.33 KWH.
Current required per ton of steel welded	5.83 KWH.	
Welding machine months	7.5	8.0
Steel welded per month per machine	140 tons	197 tons
Fillets (⅜ in., ½ in., ⅝ in.) per machine per mo. in lin. in.	8069	
Fillets (all ⅜ in.) per machine per month in lin. in.		8175
Erection started	Apr. 9, 1930	June 2, 1930
Welding started	Apr. 28, 1930	June 6, 1930
Erection completed	June 26, 1930	Aug. 5, 1930
Welding completed	June 27, 1930	Aug. 7, 1930
Height	187 ft.	194 ft.
Width	58 ft.	95 ft.
Depth	110 ft.	184 ft.

These differences are: size, shape and location; live loads used in designing the steel frame; field-welding for all secondary floor beams in Boston and bolting for those in Wilmington.

The influence of size, shape and location of a steel frame is most strongly exhibited in the amount of welding necessary to resist the stresses resulting from wind pressure. A tall narrow building of considerable length may require this provision in one direction only as in Boston, while a structure of the same height but of much larger width, or attached to large existing structure on two sides as in Wilmington, may need no wind bracing. In a third type, consisting of great height and of small width and small length, the connections of floor beams to columns must be designed to resist wind stresses in two directions.

Obviously, the total amount of welding will change as the live load varies, but not in exact ratio, because some details are not fully dependent on the live loads—column splices for example. On account of a provision in the leases of lands on which the Boston building stands that the structure must be designed to withstand loads resulting from any possible use permitted by the zoning laws of Boston, a live load of 125 lb. per sq. ft. of floor areas was used even though at present, and perhaps for years to come, the building will be devoted to office use. In Wilmington, live loads of varying amounts were used depending on location.

Again; the Boston building code requires that all connections of secondary beams shall be field riveted, whereas Wilmington permits these to be field bolted. As the Boston Building Commissioner had granted a permit to field weld under the discretionary power granted him by the code, it was of course desirable to field weld these secondary beam connections. But in Wilmington the practice of bolting was followed. Naturally this difference reflects itself in the amount of welding involved.

Tables are presented herewith as approaching a fair degree of completeness. They should be used with care; only where applicable.

Assuming a multi-story steel frame of 2100 tons closely similar to and using the average values of two buildings discussed above, the following preliminary estimate for an hypothetical building may be made: Total time required by welders to field weld=2100 × 0.906= 1903 man-hours. Electrode (welding wire) melted and wasted=2100 × 2.01 =4221 lb. Electric energy required to field weld=2100 × 4.995=10490 K.W. H. Aggregate length of fillets=2100 × 43.775=91948 in. Welding machine months required to field weld=2100/ 168.5=12.4. Welding machines required to field weld in 3 months= 12.4/3=4.

Material Savings

A new 100-ton building, the first all arc-welded steel structure of its kind in southern California, is in the final stages of erection in Los Angeles by the Soule Steel Company of that city for the Pacific Freight Lines. The trusses used are known as "Soule Steel Truss Joints" and the welding was accomplished through the use of General Electric arc-welding equipment and type L electrode. With a crew of 10 men working on the job, the time required to erect the steel was 21 days. All plans and details were checked by the Los Angeles Building Department.

The construction company estimated that it saved considerable time, that would have been devoted to office detail and shop fabrication, inasmuch as the use of welding eliminated the necessity of making up shop templates for drilling. Because of the absence of rivet holes, it was possible to use lighter steel and at the same time obtain a more rigid building. Welding was found to be 10 to 15 per cent cheaper than other methods and, in addition, disturbing noise was entirely eliminated from the construction work.

One of the outstanding features of the new building, whose overall dimensions are 290 feet by 80 feet, is a 30-foot overhang for sheltering trucks at the loading platform.

View During Erection of Arc Welded Steel Trusses. This Method of Fabrication Saved Office and Shop Detail Work.

General Construction

In the field of general construction, as in most others, the past year has been one which has called for all the resourcefulness which an organization could command to enable it to complete a contract at a profit. As a means of eliminating delays and overcoming unforseen obstacles, the oxy-acetylene process has therefore been given more than usual consideration this year.

Among the many emergency uses discovered under the present urge by the resourceful erector, the following examples are typical:

(1) Heating a pail full of rivets for the erection of a water tower instead of waiting for a rivet furnace and fuel to be brought into position.

(2) Heating and bending six additional reinforcing bars of special shape not included in the original requisition.

(3) Cutting miscellaneous sections, bars and pipe to size without moving them to the power cutter.

(4) Welding secondary structural joints for special connections not provided for in the original layout.

(5) Cutting and welding pipe for air, water or steam, thus eliminating a large assortment of tools and fittings.

(6) Manufacturing miscellaneous fixtures such as brackets, cradles, booms, etc., from available structural sections and plate.

(7) Cutting or welding chains, hooks, clamps, tie rods, braces, etc.

From the 1931 report of the Oxy-Acetylene Committee of the International Acetylene Association.

(8) Replacing broken castings with welded structural sections resulting in substantial economy and added strength.

(9) Building up worn cams, lugs, bosses, etc., to keep a piece of equipment in operation.

(10) Cutting bolts or even wood spikes in less time than required to secure a suitable wrench or puller from the storeroom.

While these and numerous other applications are made at this time as ingenious expediencies, their successful accomplishment are leaving an experience behind them that will make their repetition a matter of universal established practice.

The oxy-acetylene torch on a construction project is no longer a special tool for a specialized trade. It is becoming a truly universal tool that can be used to cut, fit, mold and join metals into any desired shape; to make and break joints; to cut out or build up parts of machinery; to heat up and loosen a frozen bushing or expand and shrink a close fitting sleeve or collar; to cut off a projecting part or extend a short arm; to harden and temper soft member or anneal and soften a hard section.

Non-Ferrous Metals

Everdur

Everdur is a copper alloy containing approximately 96 per cent copper, 3 per cent silicon and 1 per cent manganese. Its growing popularity for use in the fabrication of tanks and containers is due to its high strength and high resistance to corrosion. It has naturally been desirable to develop methods of welding this material, and the important points of correct procedure were brought out in a paper presented at the 1931 fall meeting of the American Welding Society by M. Powell of the Whitlock Coil Pipe Company and I. T. Hook of the American Brass Company. It is pointed out in this paper that there is some difficulty in the development of a satisfactory procedure for welding pure copper due to the high heat conductivity of the material which makes it necessary to apply a great deal of heat in order to raise the temperature of the seam edges to the melting point. The relative low heat conductivity of Everdur minimizes this problem and makes it unnecessary to resort to pre-heating.

In working out a welding procedure, the first objective is sound weld metal with perfect penetration or bond to the base metal. The next objective is to improve the weld metal as much as possible by such operations as peening and annealing.

This material should be welded as rapidly as possible. As an illustration, a welder familiar with the welding of steel was given a 12 in. seam in ½ in. Everdur plates to weld, using the oxy-acetylene torch. He executed the weld in 26 minutes. He was then told to weld a similar pair of plates just as fast as he could fuse the metal, and he did this one in 8 minutes. Tests on the first weld over which he had taken so much time showed an efficiency of only 51 per cent, while those on the weld where the welding had been speeded up showed an efficiency of 73 per cent. The reason for welding rapidly is that it is desirable to keep the shrinkage stresses in the red hot metal as low as possible, and the best way to avoid stresses is to cut the flow of heat into the base metal as low as possible. Moreover, the most homogeneous solution the metal can have is that of its liquid state. Hence, the quicker the metal is solidified, the more uniform will be the cold metal and the finer its structure.

The second general principle is that where maximum strength and ductility in the weld is desired, steps must be taken to eliminate the locked up stress and to restore the structure to one similar to that of the rolled sheet. For this purpose some form of cold work, such as rolling or peening, followed by an anneal, will be found desirable, particularly in thick sheets. For sheets ⅞ in. and less, the cooling is so rapid as to give excellent strength and ductility in the weld metal.

Some preliminary tests made with the metallic arc in ½ in. plates indicated that locked up stresses were of little moment, so that there was no gain by annealing. It was further demonstrated that annealing produces no benefit unless the weld metal is first cold worked. These welds were made in four beads with a 5/32 in. diameter electrode, 190 amperes and approximately 28 volts at the arc. A specimen hammered but not annealed indicated that the hammering of the first beads followed by the welding heat of the later beads gave a refinement to the structure of all but the last bead. The benefits of cold working are shown in improved yield point and tensile strength. It was also shown that cold working followed by an anneal of approximately 650 degrees Centigrade causes an improvement in both tensile strength and ductility.

A further series made on thicknesses ¼ in. to ¾ in. covered both gas and arc processes. In the arc welds a 5/32 in. electrode with 190 amperes and approximately 28 arc voltage was used. Each bead was peened thoroughly with an air hammer. The gas welds were made in one pass in a single V-groove and the welds peened on top and bottom.

All of the welds on completion were annealed with a gas torch at approximately 650 degrees Centigrade. It was found that when annealing with the torch, the anneal should start from an inside point and finish at the edge where the seam runs out to an edge.

In actual practice, shell seams in ¼ in. Everdur plate were successfully made with a 90 degree single V bevel in a single pass by the back step method, the seam being tacked at 12 in. intervals. A reinforcing bead was run on the inside and both sides were hammered with an air hammer. After hammering, the welds were annealed with a gas torch at about 1200 degrees Fahrenheit.

In shell seams in ½ in. plate, the longitudinal seams were of the double V type and welded in three passes, the opening on the outside was twice that of the one on the inside. The first pass filled the outside V about one-half full. The seam was immediately turned over and the inside V filled with a second pass. These two beads were then hammered, using two air hammers working directly opposite each other. The outside bead was hammered with a flat smooth tool. On the inside bead the tool used was round and slightly convex, also smooth. The third layer was then applied on top of the first and hammered, using the same tool used on the inside. All the welds were made with 190 amperes on a 5/32 electrode and a sprinkling of flux on the seam. The annealing of all welds was done with gas torches at 1200 degrees F, this temperature being estimated by the color, a cherry red, noted on the side of the seam opposite the torch.

The arc made between Everdur rod and Everdur plate is most effective with the electrode positive. There is no apparent crater and to the welder used to welding steel, it would seem that no penetration was taking place. Because of this characteristic, it is necessary to prepare the joint to be welded with a little greater opening than for steel welding, and to use a backing-up plate, preferably of copper, under the seam.

Aluminum

The use of the electric torch for welding aluminum is described in detail in the Book of Applications pre-

pared by the Warner Engineering Company, Pomona, Calif. The electric torch consists of a holder carrying two carbon pencils, the arc being struck between the ends of these carbons, producing an arc flame which can be directed against the material to be welded. When the proper heat adjustment has been made, the handle is squeezed so that the ends of the carbons are brought firmly together and held there until they are warm; then the tips of the carbons are allowed to separate until an arc approximately ⅛-in. long is drawn. The heat can be reduced by increasing the gap between the carbons or making a different current adjustment on the machine. The chemical character of the flame is unchanged by the width of the gap unless the carbons are held too closely together, in which case there will be a slight carbon discoloration on the work. The flame is projected directly ahead of the carbons, so the torch must be pointed at the work at an angle of about 45 degrees. This will give the desired penetration on aluminum up to 16 gauge and at the same time sufficient preheating ahead of the pool of molten metal to give a fast, clean weld. On heavier metal, the angle of inclination is increased up to a limit of nearly 80 degrees. This change of angle insures penetration so that by varying it any desired bottom bead can be obtained. If a bottom bead is desired, the material should not be supported beneath the weld.

The operating instructions are: Grasp the torch as you would an ice pick, adjust the spring to a comfortable tension, break the arc, then touch the inner cone of the flame to the work. A circular motion is recommended for aluminium welding, as it has been found the fastest way of making a clean, strong weld. Less motion is necessary than with a gas torch, and the weld is preferably made narrow and rapidly so as to have a minimum area affected by the heat.

The temperature of the metal should be kept down as nearly as possible to the melting point so as to reduce the formation of oxides. Adherence to this rule will mean greater strength and ductility.

Although the arc flame is not oxidizing itself, there is a chance for formation of oxides because of the surrounding atmosphere, so the use of a flux mixed with water to form a thin paste for coating the rod is recommended. A ⅛ in. rod is recommended for the lighter gauges. Wherever the work is clamped down or otherwise unable to contract or expand, an aluminum rod containing 5 per cent silicon is recommended. Such a rod is also used with aluminum alloy sheets to prevent stresses in weld as the sheet cools. If proper technique is developed, the weld can be buffed to a true color on either aluminum or aluminum alloy materials.

It is necessary to wash the work after welding. This may be done with a 5 per cent solution of nitric or sulphuric acid or a solution of baking soda, one cup to a gallon of water. If the acid solution is used, it should be neutralized with a mild bath of baking soda. This washing is necessary to remove the excess flux so as to prevent corrosive action.

With this procedure, it has been found unnecessary to bevel or notch sheet aluminum up to 10 gauge before welding.

Maintenance Welding

Engine Casting

By F. L. Berry, M. I. Mech. E.

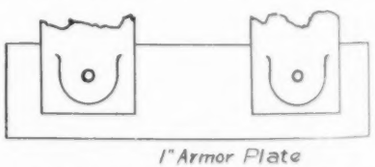
An arc welding repair job of more that average magnitude and difficulty was carried out on the main frame of a 700 Horse Power Locomobile type engine, on which the frame and all motion work and cylinders were carried on the top of the horizontal tubular boiler.

The mishap was due to a loose cotter which allowed the crosshead pin on the high pressure side to work out of position with the result that the connecting rod became a battering ram driven by the momentum of a heavy flywheel and high speed crushers, the engine itself running at 180 r.p.m. The rod smashed through the bottom slide bars and broke the shoes, rammed the piston back against the back cylinder cover, and buckled up the rod. The frame itself was completely fractured in a transverse direction, the casting being severed from the high to the low pressure sides. There were also longitudinal fractures. In all, the frame was in six pieces, separate and distinct, with other cracks running in several directions, these lines being partly indicated by the white lines on the photograph.

White Lines Indicate Extent of Weld.

As a first step the broken parts were very carefully assembled in position—the fractured edges being trimmed to make this possible—and tacked together by temporary studs and plates, the transverse fracture being pulled up tightly by means of strong tie bars running longitudinally. When this was sufficiently rigid, the casting was put back in its normal working position and firmly bolted down into its original seating blocks. A deep groove was then chiselled along the line of fractures wherever it was necessary later to weld together the severed parts. The groove was made in the form of a "V" about ¾ in. wide at the top tapering to nothing at the other side of the metal, which was 1⅝ in. thick in the body of the casting. Altogether the total length of crack so treated was 92 feet, and by running the men in short shifts the welding was done in nine days. So far as was possible all the welding was done from the top of the grooves, which were cut with the mouth upwards. When all was cleaned up, welding was started and fresh metal fused into the gaps, with a slight covering overlapping. The casting was not removed or unbolted during this operation, nor afterwards.

It was thought that there might be some distortion after the welding had been completed, and the bolts were slacked off temporarily to see if there was any undue spring. There was none, and it only remained to see whether any welds would open out on working, but with the exception of a slight crack that opened so little that it was only discovered with a microscope, and the beat of the engine, all the welds held good and sound. The surplus metal left by welders was removed from the sides by means of Carborundum sticks, and emery, and there was not even any heating up after the first three hours.



Method of Reinforcing the Feet to Relieve Strain.

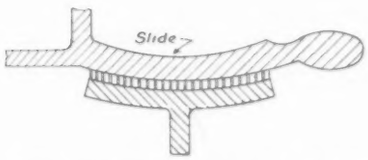
The engine was run lightly for a day, and the next one carried the load, and from then on for eight months the engine ran, until during an annual overhaul a new casting replaced it; not, that it showed any signs of requiring replacing, but simply because the new one was there.

The success of the job may in part be due to the manner in which the frame

was relieved as far as possible from all avoidable strains. Those due to the pull of the pistons tending to open out the right angle weld on the transverse fracture were taken on strong tie bars screwed into the front flange of the cylinder—replacing the cover studs in three cases—the other ends being attached to the crank case end of the casting; the stays were warm when screwed up and as they cooled added to the normal tension that due to contraction, helping materially to keep the strain off the weld.

The feet of the casting were then fitted into openings made to fit them in a heavy steel plate notched out to receive them. The feet were made a tight fit, and held the casting together at the lower side and prevented the feet spreading under the thrust of the pistons, the plate being attached by welding to the feet of the casting.

As it was feared that the downward thrust of the connecting rod might have a tendency to push out the triangular bottom part of slide that had been welded in position, a light casting was run around the under side of the frame following the curvature of the slide bars, a small space being left between the two surfaces. Into this annular space babbitt metal was run and pulled up tightly so that the strain from the bottom of the slide was transferred to the casting through the babbitt, making a really sound and firm job.



Lower Section Is Auxiliary Casting. Space Between Castings Is Filled with Babbitt.

Steam Jacket

An excellent example of the technique of repairing cracked gray iron castings of unusual shape was recently demonstrated at an explosives manufacturing plant by an oxy-acetylene service operator in connection with the reclamation of a fractured steam-jacketed kettle, and the following details of the job were given in a recent issue of *Oxy-Acetylene Tips*.

Inspection showed a 4-ft. diameter kettle about 2 ft. deep with a steam jacket, which was an integral part of the casting, running circumferentially around the lower half in which there was a crack about 2 ft. long. The crack was also in a circumferential position on the outside of the jacket, parallel to the lip of the kettle.

Knowing the high cost of a new kettle (about $500.00) the plant superintendent did not care to scrap it until he was certain it could not be repaired. Because of the nature and location of the fracture, the plant shop had hesitated to attempt a repair.

The service operator suggested that he be permitted to supervise a repair welding job, as he saw no reason to believe that with the proper procedure for bronze-welding carefully followed, it could not be put back into service again.

Accordingly, the plant welder was instructed to clean off the metal thoroughly adjacent to the crack, and then to vee the entire fracture to a point about 2 in. beyond each end. Chipping further than the visible end of the crack made certain that the actual end had been reached and prevented the possibility of the crack extending further during welding.

Further analysis of the probable stresses that would be set up in the cast iron on applying the welding heat convinced the service operator that with bronze-welding the heat would not be great enough to necessitate any preheating, either local, or of the entire kettle. He figured that any expansion that would take place would be in an outward radial direction, and since the crack was on the outer rim of the jacket bulge, as is shown in the accompanying illustration, it was as though placed on an expansion joint. The consequent contraction of the metal after welding would not, then, tend to place much strain on either the weld metal or the adjacent cast iron, but would rather act to draw the welded crack inward in much the same fashion as a section of a bellows. This compressive stress in the weld would be easily taken up by the ductility of the deposited bronze weld metal.

Having thus carefully worked out the probable reactions, the bronze-welding was started. As it was necessary to work on the vertical side of the kettle, a shoulder of bronze was first built up on the cleaned cast iron surface just below the crack and parallel to it. This gave a firm foundation to work on and the bronze-welding of the fracture was soon completed.

Bronze-Welding the Steam Jacketed Kettle.

The final operation was a hydrostatic test of 40 lb. per sq. in. pressure, which was twice the normal working pressure of the jacket.

Hard Surfacing

Textile Mills*

By S. H. Jonest

There are many hard surfacing materials now offered and the choice of the proper one is necessarily determined by the nature of the job to be done. Too often we find the purchasing agent considering only the price of material without regard to the results to be obtained. To be sure the cost of hard surfacing alloys is considerably higher than ordinary filler rod. However, when we consider the service rendered I know of no material so reasonable in cost

The application is simple and easy, there being only one rule which must be observed, and that pertains to flame adjustment. Always have an excess of acetylene, a tailing of an inch to an inch and one-half long is best. Preparation for the job is very similar to that of brazing. However, I would advise the use of the file in cleaning the surface, in preference to emery cloth or sand paper, since small particles of abrasive substance may become embedded in the work and cause blow holes.

One of the popular applications is the rebuilding of the stitch cam in knitting machines. As small as these parts are it has been found profitable to recondition them—the cost isn't greater than the cost of new parts and their service has been increased more than 400 per cent, meaning also that your stock of seconds caused by worn stitch cams will be only one-fourth of what it formerly was. In this class of work always try to make the application starting at the point or small sections and work toward the heavy portion. This procedure protects the light part of the job. Be very careful of the

*Extract from a paper "Oxy-Acetylene in the Textile Industry," read before the Second Annual Welding Conference, Georgia School of Technology, Atlanta, Ga., Jan. 27, 28, 1932.

†Burdett Oxygen Co., Atlanta, Ga.

points and edges of this work so as to obtain a sufficient amount of material. This is a change from the accustomed procedure of lifting the rod before the flame and after lifting the flame first then slowly and carefully lift the rod. Surfaces produced with hard coating material cannot be machined and grinding must be resorted to for all finishing. You will find that many parts must be heat treated to meet the required working condition. When such is the case proceed with the treatment without considering the deposit.

There is one consideration the manufacturers of hard coating material have not met—that is the production of a rod small enough for this work, so it becomes necessary for us to care for our needs by doing what the speaker terms "Drawing." This is done by placing the rod on some material such as a brick or metal table and heating to the molten stage. Using a rolling and drawing motion, next gradually move the rod away from the molten portion until the desired size is obtained.

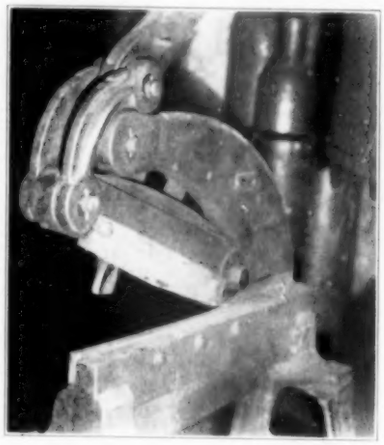
Shears*

With the introduction of alloy steels, machinery must, in many instances, be redesigned to cope adequately with the superior properties of the new materials. Greater strength or hardness may be required to enable equipment to work the alloys as cheaply and efficiently as ordinary steel. In many cases this necessitates the installation of new machinery because of the impossibility of making the proper transformations in the old apparatus.

This, however, is not always true, for it is often possible to meet these new demands by changing a few parts or treating them in such a way that they can come up to specifications. When greater surface hardness or wear resistance is a prime requisite for a machine, certain hard-facing materials are particularly well adapted to furnish the necessary qualities to the part. Readily applied by the oxy-acetylene process, frequently without even the necessity of dismantling the equipment, hard-surfacing is fast becoming indispensable around the welding or machine shop.

An example of this type of equipment improvement is found in a welding shop in the East. Considerable plate work is done at this plant, so a small shear was installed to facilitate cutting the material to size. This was entirely adequate to the needs of the shop until the advent of stainless steel. When this tougher ¼ in. plate was cut in the shear, the blades were literally chewed to pieces in a very short time. This resulted in frequent replacements, serious loss of time, and unsatisfactory finish on the edges of the sheared plate.

It was finally decided to try hard-surfacing the blades in order to reduce wear to a minimum. Both edges of the shear coming in contact with the stainless steel sheets were coated in the usual manner with a thin layer of Haynes Stellite. The hard-surfaced shear has been used approximately two hours a day for the past two years for cutting stainless steel, and so far very little wear has been noticed. While no accurate records were kept of the life of the tool steel blade formerly used, the foreman of the shop stated that the hard-faced blades had already outlasted the ordinary blade many times over, and that he was greatly pleased with the results obtained.



This Hard Surfaced Blade Cuts Alloy Without Wear.

This application of hard-surfacing is but one of many that will be found to be decidedly advantageous when a shop is planning to redesign and improve its equipment so as to meet the requirements of alloy steels. Practically any machine part that is subjected to excessive abrasion offers a potential opportunity for the profitable application of hard-facing material and the greater hardness of many of the new materials practically demands that such parts as shear blades be hard-faced so that they will have longer life and greater efficiency in operation.

Highways*

Regardless of the type of construction or maintenance, whether it is the construction of new concrete highways or the construction and maintenance of dirt and gravel roads, it is quite obvious that the equipment used in this work is subjected to rough usage and severe abrasion and that frequent replacements of worn parts are necessary, with accompanying high operating and maintenance costs.

Many new roads under construction and other roads requiring constant maintenance are often located at great distances from repair shops and sources of supply of spare parts. Replacement of parts and repair of broken and worn parts are not only costly, but result in delays and loss of time and production. Therefore, any method that will prolong the life of these parts or any process that will result in reduction in maintenance and operating cost, is highly desirable and essential.

The equipment used in the construction and maintenance of highways represents an enormous investment, and it should, therefore, be utilized efficiently and to the maximum capacity. Highway contractors have realized full value on their investment and effected worth while savings by maintaining welding and cutting apparatus on the job for immediate repair of broken parts and for hard facing the surfaces of machine parts subjected to abrasive wear. Welding and hard facing can be readily applied on the job, reducing loss of time for shutdowns, repairs and replacements.

Machine parts, such as subgrader blades, roll-over scraper edges, orange peel and clam shovel bucket lips and teeth, router plow points, scarifier teeth, excavator lips, teeth and wearing pads, tractor treads, links and sprockets, concrete mixer discharge chutes, mixing paddles, centrifugal pump bodies and intake and discharge openings, are a few of the many hard surfaced parts of highway equipment.

Manufacturers of road building equipment have also taken advantage of welding and hard facing in the manufacture of their equipment. The substitution of welded joints for riveted and bolted construction has resulted in an improved product. The welded construction presents a solid unified structure, which better resists the torsional strains and vibration to which the equipment is subjected. It has not been necessary to entirely redesign this equipment except to specify welded joints instead of the riveted and bolted construction, although in many cases it has been possible to reduce the weight of the entire structure because of the increased strength of welded members.

Many progressive manufacturers of road building equipment have recognized the possibilities of welding in their manufacturing processes and have standardized on welded units of structural steel parts cut to shape. In many cases these manufacturers also apply a hard facing on the wearing surfaces of their equipment.

*From Oxy-Acetylene Tips, Feb., 1932.

*From the 1931 report of the Oxy-Acetylene Committee of the International Acetylene Association.

Keep the Welder in Sight—He Can Help You Develop New Operating Economies

Modernizing for Profit

Welding for profit under 1932 conditions calls for stopping the leaks, improving designs, using methods and materials that lower operating costs. Modernizing will increase profits where "penny-pinching" fails.

EVERYWHERE in industry, there are activities indicating that the more capable executives are meeting present conditions through readjustments, instead of simply waiting for a boom period to develop. There are several factors which make this readjustment necessary. Lower price levels make it imperative to develop new operating economies. The falling off in demand for products, which have had a good market in the past, automatically points to a demand for new values to offer to the public. New values arrived at by using better materials and new methods of manufacture which give the product longer service, attract new buyers. The *product* must be *improved* and production *costs* must be *lowered*.

Limit of Welding Modernization Yet to Be Reached

There is much opportunity in the welding industry for readjustment through the modernization of equipment and methods. Some will say that the welding processes are the most modern developments in industry, and that firms who are using these processes for either production or maintenance work are already modernized. This statement is true only to a limited extent. It is only necessary to look back a couple of years or so to find important advances which have been made in all of these processes. In the gas welding field there has been the development of multiple flame equipment and procedures using the unbalanced flame which have made startling reductions in operating costs. In the arc welding field the rapid development of the shielded arc process has likewise reduced costs and has made it possible to use this process on applications for which it had been considered unsatisfactory in the past. In the resistance welding field, projection welding and flash welding have come rapidly to the front supplanting the older methods of spot welding and butt welding, reducing costs and making still more new applications possible. Welding wire manufacturers have improved their products, making it possible to accomplish results of tremendous economical importance.

Wherever welding equipment is being used only for the purposes for which it was purchased five years ago, or wherever welded products are being made with the same procedures and the same designs that were satisfactory five years ago, there is almost certain to be a large opportunity to build business and increase profits through modernization.

Despite the difficulties involved in obtaining capital for improvements in equipment, there are some bright spots in this part of the picture. The Reconstruction Finance Corporation has not yet been in action long enough to show what its probable influence will be, but there is little doubt that this organi-

zation will soon have the effect of making it easier to obtain money for such purposes. There is also indication that manufacturers of industrial equipment may give more attention to installment selling in the future, so that plant improvements can be made self-supporting in a much larger degree.

Look to the Operation

In the welding industry modernization of equipment and methods can be applied to both production and maintenance work. Where there is no chance to create new business through the redesign of the product, or the substitution of new products for old ones, and the plant executive must look to lower costs rather than increased business, there are several things to be done. Production can be "speeded up" by the use of automatic equipment or by the replacement of old equipment with newer equipment, better suited to the work. The welders' working time can be decreased by more careful attention to the use of jigs, by using unskilled workmen as helpers for handling materials and preparing the work, so that the skilled operators devote a larger portion of their time to the actual welding; and the designer by getting better acquainted with the fundamentals of welded construction can decrease the amount of welding by placing the weld metal where it will do the most good.

Handling costs can be reduced by giving more attention to the conveying and material handling equip-

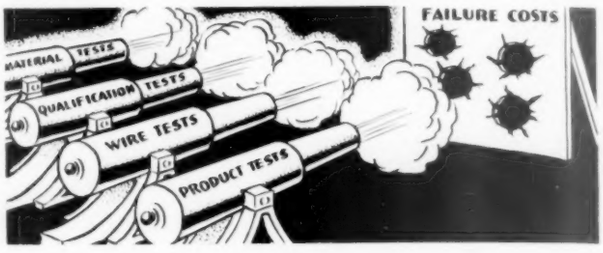
When Profits Start Falling It's Time to Wake Up the Designing Department.

ment. Straight line production methods are responsible for the profit showing of many shops. Welding departments are inclined to overlook this principle and to figure on making all of their economies in the welding operation itself. It must be remembered, however, that by putting the most efficient practices into effect in the welding department the operating efficiency of the plant as a whole is increased.

Place Management in Capable Hands

It is essential to a modernizing program in this industry that the responsibility for welding operations be centralized. There must be a willingness on the part of the management to provide for one executive to direct the entire program and this executive must make a scientific study of the work to be done. One large plant adopted this policy a short time ago and the new executive head of welding operations started a scientific investigation. Among other things, he found that four grades of welders were on the payroll with a sliding scale of wages according to ability. The study showed that this was really not economical. The fourth grade was gradually eliminated and it was not very long until the third grade was almost eliminated. Using a better grade of operator throughout decreased the cost of operating—although the rate of pay was higher.

A scientific study of operating methods will also point to a need for modification of inspection and testing methods. These serve to prevent weld failures with the attendant high cost of rewelding or replacement of defective work.

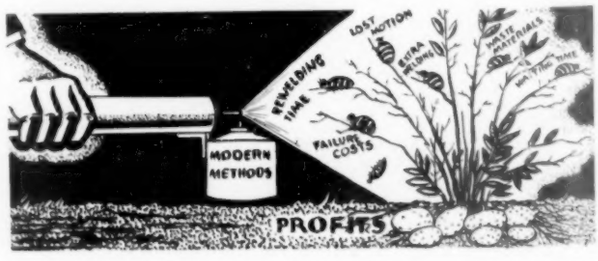


Turn This Battery Loose on Failure Costs—Blow Them Out of the Picture.

Plants which are modernizing, if they are doing a complete job, are able to show decreased operating costs and improved products. These improvements in the products represent better values to the public and loosen the purse strings of the cautious buyers. Many manufacturers are now making a strong feature of welded construction as a guarantee of satisfactory service. A perfect welded joint is a strong selling point.

Give Careful Attention to All Phases of Maintenance

Where the welding processes are used for maintenance work it is likewise desirable to centralize the work and the responsibility for it as far as possible. The responsibility for results is being placed with men who will study the new developments and familiarize themselves with the applications of welding which are being made in all industries. More thought should be given to calling upon the welding department to improve plant equipment as well as keeping it in repair. There are undoubtedly opportunities to make plant improvements by utilizing scrap material or inexpensive shapes. A large scale application of this idea is found in the extensive repairs which have been made to steel bridges by railroad companies in recent



Potato Plants Are Treated Scientifically to Protect Their Profits —Do the Same with Industrial Plants.

years. The small expense which has been necessary to make these bridges thoroughly serviceable for a long period of years in the future has saved the railroad companies literally millions of dollars which otherwise would have been expended in new construction.

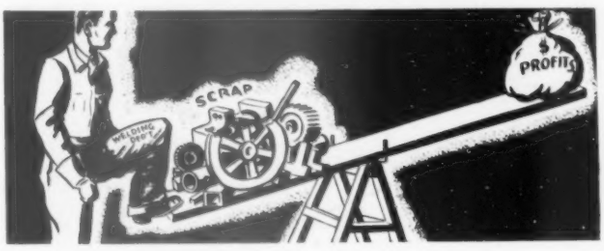
The centralizing of maintenance welding operations "speeds up production" just as it does in production

work, the welder spending his time on the work for which he is trained, instead of wasting hours of it in traveling from one place to another. The centralized shop also allows the use of time-saving and cost-cutting jigs and handling devices for repairs which are more or less constantly in demand. Real operating economies in maintenance welding can best be determined when the work is centralized and subjected to intelligent control. The advantages of installing better equipment and of using better materials become more apparent.

With such a set-up there is a better chance to cheat the scrap pile. There will be fewer requisitions for new parts to replace those which are broken or worn. The systematic operation will lead to better results, fewer failures, more work and bigger dividends from the available equipment.

The commercial welding shop is by no means to be ignored in this discussion of modernization. There is a line of business which has a rosy future before it. The most active shops at the present time have their work divided between repair jobs and production jobs. They are generally well posted on new developments in the various processes. They are in a splendid position to increase their volume of production work. A few of them have already developed into hustling profit-making manufacturing concerns. Some of them in the future will develop into real welderies. Some of them are finding it profitable to modernize their equipment. All of them will find it profitable to modernize their programs by giving more thought to the possibilities of production.

The welding industry can profit by modernization,



As the Scrap Pile Goes Down Profits Go Up.

by improving its equipment and its methods. In this brief discussion it is impossible to go into detail and relate examples to illustrate all of the points involved. Articles in future issues will do this. Case studies will be presented showing how progressive plants are reducing production costs, increasing their business and building profits by modernizing.

Soldering the Stainless Steels

By V. W. Whitmer†

IN soldering any metal it should be remembered that such a joint is one of surface adhesion only. It is not an alloy of one metal with another metal, nor is it a homogeneous mass, such as a weld or fusion. Rough surfaces present numerous fingers or projections which give the solder something to hold to. Hard, smooth or polished surfaces, on the other hand, supply no means for anchorage. Consequently, such joints may be weak. Hard, stiff materials if deformed after soldering, will put more strain on the joint, as it will probably be the softer of the two materials. Rupture may occur. Soft materials, like copper, will bend easily after soldering, as the joint is just as strong as the sheet, if not more so. Here failure is very infrequent.

Because Stainless is one of the stiff metals, it is necessary to make the joint mechanically strong in itself, if any particular load is to be carried. Joints should be lock-seamed, riveted, or otherwise strengthened depending on the solder primarily as a seal, or in some cases, a fillet.

In making such joints, if very smooth or polished sheets are used, the edges should first be roughened with a coarse file or emery wheel. If this is impossible, a mixture of 50 parts Ferric Chloride in 100 parts Muriatic Acid and diluted two or three to one should be applied to the surface with an acid swab and allowed to set for 10 to 15 minutes. The mixture should then be carefully removed so that it will not touch elsewhere on the sheet. This method will etch the surface sufficient for tinning. No such preliminary treatment is necessary if rough pickled sheets are used. A good Stainless Steel soldering flux, such as "All-Sol"[1], or "Spears"[2], is then applied the same as cut acid and the edge tinned, using ordinary commercial half-and-half solder. After tinning, wipe off all excess solder, leaving only a fairly thin film. In the case of a lock seam, tin both sides of each piece.

After tinning the joint should be lock-seamed, riveted or properly strengthened by other means. Then, using either the same flux as before or cut acid, sweat the joint with more solder, the same as if working tin, terne or any other tinned product. No precautions need be taken

Sears Parking Entry of Soldered Stainless Steel.
(Illustration by Courtesy of L. B. Allen Co., Chicago.)

with the irons other than those employed in everyday practice. In view of this a larger iron will be beneficial, as it will supply more heat for running a longer seam without the detrimental effects from warping caused by too high a temperature. If special analysis solders are required, such as 60-40 or even Block Tin, the same procedure should be followed. Do not have the irons any hotter than necessary, otherwise warping or buckling will result.

After completion of the work, all the joints and preferably the entire job should be washed with a solution of soap and 5-10 per cent soda to neutralize any acid which may still be present. If not removed, the acid may cause small pits and etchings, especially on polished sheets. Rinse with clean water and wipe with dry soft cloth.

†Welding Engineer, Republic Steel Corporation.

[1] *"Allen All-Sol for Stainless Steel."*
[2] *"Spears Soldering Fluid, Grade Super."*

Steel in the Home—More

Arc Welded Steel Frame House in Oberlin, Ohio.
Nine Tons of Steel Were Used. Structural Shapes Were Cut to Length and Welded Together in the Shop, Forming Sections Which Were Assembled on the Building Site. Cost Was Only Slightly More Than Wood Framing. Metal Lath Is Used on Walls, and Floors Are Concrete Over Metal Lath with Composition Finished Flooring. Photo by Courtesy Lincoln Electric Company.

Many interested firms are giving much time and attention to the possibilities of the steel home. The idea has many possibilities and much prospect for industrial activity using as it will large tonnages of steel when once the

CONSIDERABLE progress has been made by the manufacture, commercially, of light-weight steel members, such as light-rolled shapes having thin flanges and webs, or of shapes formed from sheet steel. Other light steel members include lattice truss floor joists made from steel bars welded at the joints. These light steel members appear particularly suitable for house construction in which the loads are much lighter than those in most engineering structures.

Metal and particularly steel members have, until recent years, been joined by rivets. Welding, either electric or gas, has, during the past ten years, been developed to the point where it is now recognized as a satisfactory method of fabricating metals. Welding is particularly suitable for comparatively thin members such as are used in houses. In general, the cost of preparing the members for fabrication is less expensive than for riveting and this work does not have to be done so accurately. Usually all that is necessary is to cut the member to the desired length. Unless the riveted joints have gusset plates, etc., the strength of welded joint is, in most cases, greater. This is especially true for the thin members used in houses.

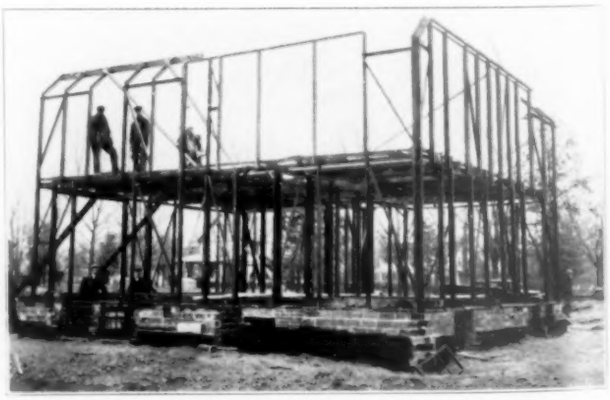
Equipment, readily portable, is available for use in the field but the economic advantages of shop fabrication for welded structures are so great that if the metal house comes into use, we will soon see large fabricated aggregates welded in the shop.

There are theoretical advantages in using tubular members instead of angles and I-sections. They are stronger when loaded as columns and as beams if they are fabricated into a truss. The extensive use of metal tubes in the structural portions of airplanes shows that for a given strength the weight is less than for other shapes of cross-section.

If houses were designed to use steel tubes for the structural framework, there is no doubt that they would be amply strong and the weight would be low. Moreover, the tubes having thin walls are much less likely to be damaged in shipment than rolled shapes having thin, outstanding flanges. In the past the cost of tubes has been higher than the cost of equivalent rolled shapes. The recent development of tubes made from sheet steel formed into a tube and having the longitudinal seam welded may make them available at a reasonable cost. When this time comes we may expect to see tubes used for house structures because welding offers a much cheaper and more satisfactory method of fabricating tubular members than either threaded connections or riveted joints.

Shop fabrication of metal houses may develop along any one of several lines. First, structural members may be ready-cut in the shop and then assembled in the field, preferably by welding. Second, open frames may be assembled in the shop by welding or by other means, perhaps using wires under a high tensile stress for diagonal bracing. These frames, light in weight and not likely to be damaged in transit, may then be shipped to the building site and erected easily.

Welding, in all probability, will prove to be cheaper and more satisfactory than any other method of joining these frames in the field. An estimate which is sufficiently interesting to deserve consideration here has been made for the shop-welded steel frame of a typical six-room residence containing about 6½



Arc Welded Steel Frame of Residence at Oberlin, Ohio.
This Structure Is the Work of Steel-Bilt Homes, Inc. The Frame Shown Was Erected on the Foundation in Approximately Two Days. Erection Cost Was $90.00 a Ton, and Contractors Anticipate That This Can Be Reduced at Least $20.00 a Ton. Photo by Courtesy Lincoln Electric Company.

Extracts from a report of the Correlating Committee of the President's Conference on Home Building and Home Ownership.

Work for the Welder

advantages have been impressed on the home buyer. That the idea is economically feasible is at once apparent when the high costs of present methods of fabrication are considered.

to 7½ tons of steel. The shop-fabricated aggregates were designed so that the field erection and welding were expedited. Experience shows that a gang of six men and a foreman, using a mobile crane, would erect the house, including the steel for the floor and roof, in two or three days, if the foundation had been properly prepared. The joints would be secured temporarily by C-clamps, then welded and the clamps removed. Assuming that the oxy-acetylene torch was used for the field welding, the gases would be transported to the building site in steel cylinders. The cost of 100 cu. ft. of the two gases, delivered, ranges from $1.75 to $2.50. Roughly 25 to 35 cu. ft. of the gases provides sufficient heat for the deposition of one pound of weld metal which will join ¼ to ½ ton of residence construction steel. A welder will average from 8 to 12 lb. of deposited metal in an 8-hour day. Excluding overhead, the cost of labor and materials for the field welds would be about $50.00. A similar estimate for electric welding is not available but it may be expected to be about the same. Only after this method of construction has been used for some time will accurate cost data for a particular size and type of steel frame house be available.

After erection the structural frame may be inclosed, using brick veneer, stucco on metal lath, etc. Metal floor and roof panels, concrete or gypsum slabs, preferably precast, could be used to advantage instead of wood construction. Cork blocks have been used between the upright steel members and stucco applied directly on the outside and plaster on the inside. If the house is to be stuccoed it is evident that the steel mesh should be attached to the frames in the shop by welding, then the stucco applied in the field after the insulation is put into place.

Steel House Announced by Insulated Steel Floor & Wall Company

This Is a Type of Construction Which Utilizes Pressed Sheets in Such a Way That No Structural Members Are Necessary. It Will Require About 14 Tons of Sheets from 16 to 20 Gauge, and Is Expected to Cost Less Than an Ordinary Frame House. Small Units Are Welded Together in the Shop and Assembled by Welding in the Field. Photo by Courtesy American Rolling Mill Company.

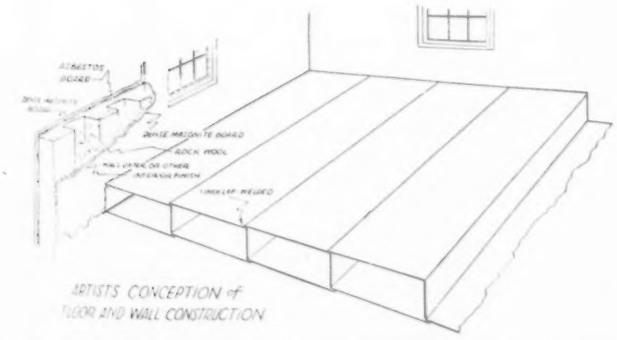
Third, the shop fabrication may be carried further by enclosing the frames on the exterior and interior surfaces. Methods will, undoubtedly, be found for finishing these surfaces so that nothing need be done to them after they are erected.

Metal floors suitable for small houses are now available. Lightweight rolled I-sections have been used considerably, especially for the first floor, to prevent the spread of a fire in the cellar. A reinforced concrete slab is supported on these beams which encases the upper flange of the beams, making bridging unnecessary. The finished floor may be wood linoleum, or rubber tile.

The cost of such floors complete has been estimated at from 26 to 30 cents per sq. ft. and for floor of the usual wood construction from 15 to 18 cents per sq. ft., the cost depending upon the location. The battle-deck floor consisting of light rolled I-sections, about 4 inches deep spaced about 2 feet apart, upon which steel plates about $\frac{3}{16}$ inch thick are laid and the edges welded over the center of the flange of the beam, has been used in houses with a finished floor of linoleum or similar material.

Floors of sheet steel formed into corrugations and spot-welded to give a cellular structure are being developed, which appear to use the material efficiently. These and similar floor panels, having a width of say two feet and a length equal to the width of the room, appear suitable for shop fabrication, complete, ready to place in position in the house and receive the finished floor. They eliminate field fabrication almost entirely and should aid in reducing the cost of houses.

The amount of structural steel commonly used in con-



Artist's Conception of Floor and Wall Construction of All Sheet Metal House.

The Floors and Roof Will Be of 16 Gauge Sheet Metal. Strips of Steel 28 Inches Wide Will Be Formed into an Exaggerated Z Shape. These Will Be Butted Together and Welded, Forming a Series of Strong Metal Boxes. A Number of Finishes Can Be Applied to the Metal Floor and the Roof Will Be Water-proof with an Asphaltic Composition. Drawing by Courtesy American Rolling Mill Company.

struction of houses is, at present, small. Usually it is not subjected to severely corrosive conditions. If it is well painted before the framework is enclosed there is no reason to fear the effect of corrosion except under very humid (semi-tropical) conditions. Corrosion of the steel reinforcement in concrete or of pipes embedded in concrete need not be feared if the concrete is well made.

For the future there is reason to believe that we will have floor surfaces made of plastics. These will be continuous sheets which adhere firmly to the structural floor and which are safe, comfortable, and pleasing. The decorative effects will be unlimited and rugs will then be a thing of the past. The thickness may be only ⅛ inch, if the sub-floor is stiff and continuous. Presumably, a structural floor of sheet metal having welded joints offers great possibilities. Plastic floor surfaces might be applied in the field but are particularly suitable for shop fabrication.

With the development of roof structures amply strong to carry any load which may come upon them, even for snow loads, and of methods of making them impervious to water, the need for the sloping roof disappears. The steep house roofs which are such a conspicuous feature of our landscape should be a thing of the past, but more of them are being built every day because the conservative owners don't quite dare to have flat roofs on small houses.

If steel and other building materials are used, a flat roof requires less material and less labor than a sloping roof. There are a number of ways in which it may be made water-tight, including non-corrosive sheet metal and felt saturated with coal tar pitch. Designs for small houses having flat roofs are now being published in the periodicals devoted to home-making.

A flat roof of this kind would provide a sheltered environment and privacy, and, at the same time afford exposure to the sun and air, so essential for invalids and even for those in the best of health. It may be used for work, recreation, and social intercourse during waking hours. If used for sleeping quarters there would be little need for air conditioning the bed rooms at a considerable cost for equipment and operation.

The Ideal Application

By Paul B. Covey†

II. Design

You will remember that last month we found an "ideal" was an imaginary state of perfection. Hence, an ideal design must be one that is perfect—but it will also be imaginary.

Well, imagine that we see a large all-steel-frame building rising rapidly above the sidewalks of one of our most progressive cities. It seems to be rising almost as if by magic. There is no apparent noise or confusion. What is the explanation? The steel framework is being welded—most of the work being done in the field with very little shop work. In fact, if adequate working space could have been found near the construction site, no shop work at all would have been done—all material would have been sent direct from the mill to the job and then have been cut, fitted, erected and welded in place. This, of course, would have been ideal because of the great saving possible in freight and trucking rates and through the fact that the material would have had to be handled only once instead of twice.

But another point catches the eye. There is not a sign of a single bolt or rivet. There are no holes present of any description. All connections are extremely simple yet entirely adequate. The details of these connections are such that as each separate piece is lifted to its proper location and when lowered into place it automatically seats and plumbs itself. Gadgets are provided for securing the member laterally as well as vertically so that it can be safely used for temporary support until such time as the welder comes to fasten it permanently into place. The ease of erection is so striking. Except in the case of very large pieces one man alone can readily seat into place all material that one hoist can handle. It is almost unbelievable.

Now in the office of the construction crew it is our extreme good fortune that the welding engineer who is consultant for this particular contract happens to be on the job. He explains how every conceivable advantage has been taken in the design to effect a saving. All holes have been omitted, which means a saving in weight due to gross sections being effective and simpler connections being possible; a saving in shop expense due to no drilling or punching being required and a saving in erection cost due to no troubles in matching and reaming of holes for bolts and rivets. All sections are designed for continuity, resulting in a large saving in weight and a great increase in rigidity. Only columns, beams, channels and so forth with parallel flanges are used for main members thereby effecting a saving in details and in cost of connection material.

Returning to the job we find that an improved type of trussed joists and studs has been used for floor and partition construction resulting in an unusual saving in weight and a remarkable adaptability to location of pipe flues, conduits and so forth. This space is also available for sound and weather proofing materials. Provision has been made for readily and securely attaching and welding in place the thousand and one items of miscellaneous steel and iron construction entering into a building of such a type—metal sash, metal doors and frames, steel stairs, iron rails, heat and vent ducts, access panels and so forth too numerous to mention.

It is quite evident that a general and thorough supervision has been carried on over all phases of the design work so as to completely correlate the efforts of all departments interested in order to make use of all of the advantages of electric welding so as to attain the utmost saving—in weight, in drafting room, templet and shop expense and in field erection labor and to gain the highest increase in rigidity, adaptability and serviceability.

Next month—another trip into the land of imagination—in search of "Ideal Details for Electric Welded Steel Construction."

†*Consulting Welding Engineer, Manchester, N. H.*

What is the nature of the crystal structure of the weld metal? Of the adjacent metal? Are stresses present? What is the effect of annealing? Of cold working? Questions like these are answered by

X-Ray Diffraction Patterns

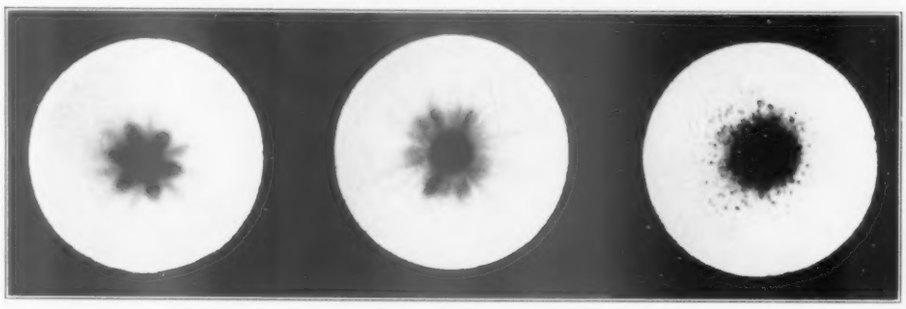


Figure 1. Examples of Three Types of X-Ray Diffraction Patterns. Left: Preferred Orientation. Center: Strained Condition. Right: Random Orientation.

MEN in the welding industry are much better informed on the value of X-ray photographs for the inspection of welds than they were a few years ago. The fact that X-ray inspection is a requirement in the construction of welded unfired pressure vessels of Class 1 and power boilers has established its practicability, and this has been further strengthened by reports of various large fabricating concerns who have installed modern X-ray equipment for this purpose. The further fact that X-ray inspection is not necessarily limited to these large structures is evidenced by the growing number of commercial X-ray laboratories, who are equipped to make inspections for firms who do not have enough of the work to do to justify the purchase of so much equipment.

Probably what is less widely understood is the difference between different methods of X-ray inspection. The first method, in many respects similar to ordinary photography, produces a radiograph, which

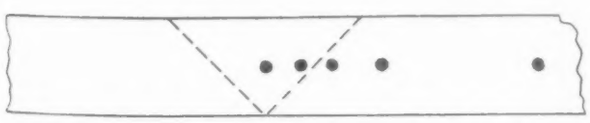


Figure 2. Dots A, B, C, D and E (Left to Right) Indicate Areas from Which Specimens Were Taken.

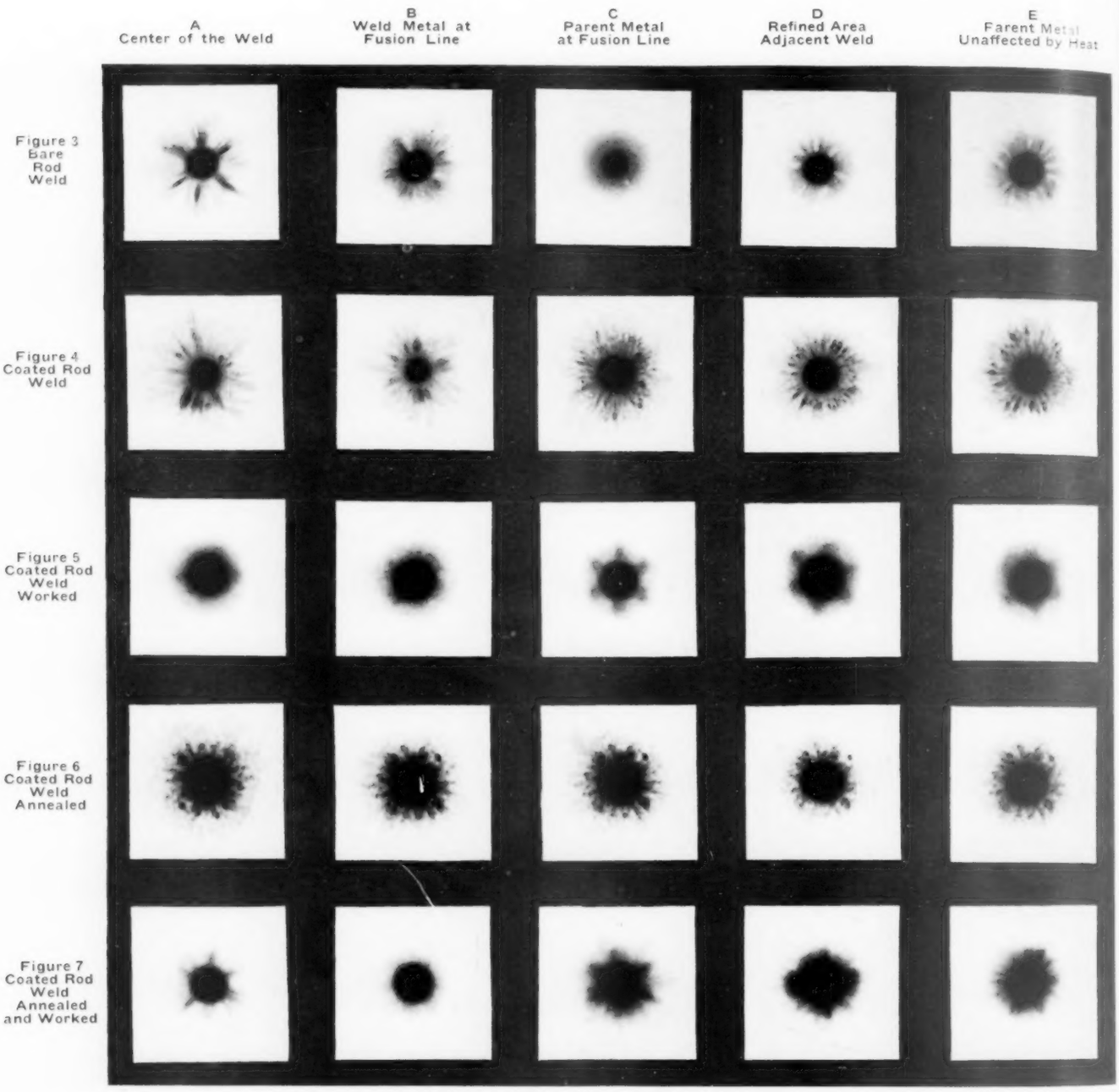
is in effect a full size graphical representation of the area radiographed, showing the size and locations of variations in the density of the object radiographed. That is, it indicates the extent of, and the location of such defects in a weld as gas pockets, slag inclusions, adhesions and lack of penetration, and by so doing shows how much the effective cross section of the metal is reduced by such defects. Within some limits the radiograph, therefore, can be used as a non-destructive method of determining the approximate tensile strength of the weld when the tensile strength of the parent metal and the normal tensile strength of the filler metal after deposit is known.

When it comes to determining the ductility (measured in terms of elongation) and corrosion resistance of the metal, or the existence of strained areas in the metal, the radiograph is of comparatively little assistance. For inspecting these qualities in weld metal, or in welded structures, another kind of X-ray picture, commonly called "diffraction patterns," is used. The field of usefulness of these patterns is the subject of the present discussion. They are valuable because there are numerous kinds of welding operations in which other qualities besides soundness and high tensile strength are necessary. The diffraction patterns will not give a definite clue to all of the properties which may be desired and it can give quantitative indications to only a limited extent, but they do give information of great practical value concerning those qualities of metal which are dependent upon the atomic arrangement and the granular structure; and the information thus obtained is valuable in predicting the serviceability of the structure or weld under working conditions.

It is a matter then of examining the crystal structure of welds or of welded articles. Bearing in mind that it is this crystal structure which determines the relative brittleness, or ductility, or possibly also the relative resistance to corrosive action, it becomes a question of how this inspection can be made and what conditions can be revealed by it which are not revealed by microphotographs.

X-ray diffraction patterns are made from very small samples of the metal to be examined, whether it be

Diffraction patterns by courtesy of General Electric X-Ray Corporation, Chicago.



In Figure 3, the Strained Condition in the Weld Metal is Indicated by the Striations. The Pattern from the Unaffected Parent Metal at E Shows That Some Strains Were Present in the Material, Patterns C and D Indicating How These Strains Were Relieved by the Heat of the Weld. Figure 4 Shows That the Use of Coating Has Diminished the Strains in the Weld Itself and Results in a Fairly Even Distribution of Strain, the Principal Change Being in the Grain Size. The Effect of Mechanical Treatment is Brought out in Figure 5, C, D and E Showing Clearly the Preferred Orientation Produced by Working. When the Weld, Figure 4, Was Annealed, the Result is a Random Orientation Throughout Shown in Figure 6. Figure 7 Shows the Effect of Working After Annealing. The Change from Random to Preferred Orientation is Obvious. (Note: Much of the Detail of These Patterns is Lost in Halftone Reproduction. Figure 3-C Has Fine Striations in the Original, and Figure 7-B in the Original Shows Preferred Orientation at the Fusion Line in the Weld.)

parent metal or weld metal. A common method of producing a pattern is to localize a narrow beam of X-rays through a tube, allowing the X-rays to pass through pin holes, then through a small, thin sample of the metal to be investigated. A special X-ray film is held behind the sample and after exposure is found to contain a dark spot in the center, while around this central dark spot are seen striations, rays or masses of small dark spots.

Just what these various patterns actually represent, and why their appearance depends upon the condition of the metal, are questions which would require a much too lengthy and technical discussion for the purpose of this article. It is sufficient to note that it is known that the atoms in individual crystals have a regularity of arrangement which is determined by the composition of the material. When the beam of X-rays is passed through the specimen, each atom becomes a secondary source of radiation and sends out secondary rays in all directions. Due to the regularity of the atomic arrangement there is a regularity of the interference of the rays so that the beam of primary radiation has its intensity increased in some portions and decreased in other portions, finally resulting in an

image on the film which is composed of light and dark areas of varying density. It has been determined also that the type of pattern produced depends upon the orientation, or positioning, of the crystal grains with reference to the direction of the beam of X-rays.

Since cold-working of metal disturbs the normal crystal arrangement it is obviously necessary to use great care in the preparation of the specimens to be examined. It is customary to use a very thin disc, which after filing down to a thickness of a few thousandths of an inch, is etched so that all of the disturbances caused by the preliminary filing is eliminated.

The method of obtaining the sample will vary according to the job. If it is a welding job, it will be noticed that the procedure does not involve a complete exploration of the entire weld as in the case of the radiograph.

Suppose, for example, it is desired to determine the effect of annealing on the weld and the material adjacent the weld, in the longitudinal seam of a tank. By fixing a test plate, projecting from the end of the seam, in the manner recommended for obtaining longitudinal test plates under the new rules for the welded construction of power boilers and unfired pressure vessels of the first class, one can cut off a portion of this test sample immediately after welding and make up specimens to produce diffraction patterns showing the structure of the weld metal, the metal at the bond, the fusion zone, the metal immediately adjacent to the weld and the parent metal in the zone beyond the influence of the heat of welding. Then the entire tank and remainder of the test piece can be annealed and a similar series of examinations made of the test sample, after annealing, to observe the effect of annealing.

Investigations may also be made by this method for determining the effect of variations of heat used, the use of chill bars, the use of different coatings on electrodes in the case of metallic arc welding and other variations of technique. The patterns themselves may be used to show the location of strained areas, brittle conditions, and types of crystalline structures which have an effect on the corrosion resisting properties of the metal.

In general, there are three important types of diffraction patterns which are of interest in connection with investigations of welds and welded structures.

1. Patterns showing preferred orientation, indicating directional properties which will persist until the metal is heated sufficiently to normalize it.

2. Patterns showing a strained condition due to the bending of the crystals. Such a condition is characteristic of cast metal and may be considered as due to the amount of heat used, which naturally would be affected by the various rates of cooling.

3. Patterns showing random orientation of the crystals, indicating a state of equilibrium and consequently a more plastic or ductile material.

Ordinarily the patterns produced in investigations of welds and welded structures will be found to fall under the second and third classifications, showing, respectively, strained conditions and the equilibrium condition. In the case of welds which have been worked, patterns show preferred orientation because of the directional properties imparted by the working.

For the purpose of illustrating typical applications of the use of diffraction patterns, two groups of patterns are shown in Figs. 3 to 7. Each of these figures comprise a series of 5 patterns made from specimens taken in the regions marked A, B, C, D and E in Fig. 2. This provides a study of the material in the center of the weld, in the weld metal next to the fusion line, in the parent metal next to the fusion line, in the refined area adjacent to the weld, and in the parent metal which has not been affected by the welding operation.

The first group is Fig. 3 and 4. Fig. 3 is a study of an arc weld made with bare wire. A comparison of the patterns in Fig. 3 with those shown in Fig. 1 indicates the typical cast structure at A and B, the strained condition at C, the refining influence of the heat at D, and the random orientation at E, indicating the more plastic condition of the parent metal. Fig. 4 shows the investigation of a weld made in the same material as Fig. 3, but with a coated electrode. There is obviously much less indication of strain and the patterns throughout the series are quite similar with the exception that patterns A and B in Fig. 4, in comparison with C, D and E, indicate a somewhat larger grain size in the weld.

It should be noted that it may have required a number of trials of different coatings and different procedures to progress from the result shown in Fig. 3 to the result shown in Fig. 4, so it should not be taken for granted that the change from any bare rod to any coated rod will produce such a marked change in the characteristics of the weld metal. However, it can be assumed, at least theoretically, that a manufacturer is endeavoring to reduce costs by eliminating the need for annealing his product after welding, and that by checking various materials and various techniques with diffraction patterns can arrive at a solution of his problem and in many instances dispense with the annealing operation.

The second group is included in Figs. 5, 6 and 7 (Fig. 4 is an investigation in the "as welded" condition). Fig. 5 is the same weld worked. Fig. 6 is the same weld annealed, after welding, but not worked and Fig. 7 is the weld annealed and worked. This gives us a picture of the effects of working and annealing independently of each other, and the effect of annealing followed by working. The whole group taken together show the possibility of close control over the physical properties of the finished product and the consequent reduction of costly failures to a minimum, obtained by scientific investigation.

Northwest Welding Congress Set for April 28-30

Announcement has been received of the Pacific Northwest Welding Congress which will be held April 28, 29 and 30, in the Public Auditorium, Portland, Oregon. The morning of the first day will be given over to registration and demonstrations in the exhibition hall, and the

congress will be officially opened by Mr. George C. Dierking, president, in the afternoon. Following the president's address will come the Address of Welcome by Mayor Baker, of Portland, Oregon, and response by Mayor Tennant, of Tacoma, Wash. There will be an address by Dean H. K. Rogers, of Oregon State College, Corvallis, Oregon. The balance of the afternoon will be devoted to special demonstrations. The morning program on April 29th will be largely devoted to demonstrations, and in the afternoon there will be a paper on "Modern Applications of Arc Welding," by A. M. Candy, Westinghouse Electric & Mfg. Co. Another paper entitled "The Old Time Blacksmith," will be read by Mr. J. Granna, of the Municipal Shops, Portland, the evening to be divided between demonstrations and reading and discussion of the paper entitled "Changes in the Welding Industry During the Past Two Years," by H. S. Card, of THE WELDING ENGINEER. The arrangements of the Saturday program are mostly for demonstrations and exhibits including demonstrations of practical welding methods by H. G. Isings, of the Woodbury Company, of Portland, and a special demonstration of hard surfacing methods by R. S. Beeler, of the Haseltine Company, of Portland.

The manager of the congress is Mr. A. Whisnant. The Executive Committee consists of W. P. Kellogg, chairman, Air Reduction Sales Company, Portland, Ore.; F. V. Romig, Beall Pipe & Tank Corporation, Portland, Ore.; E. B. Thompson, Clyde Equipment Co., Portland, Ore., and L. C. Thomas, of the L. C. Thomas Company, Portland, Ore.

Oil and Water Will Not Mix

Paul B. Covey*

WE have often heard it said, and with a degree of truth, that "oil and water will not mix". Yet I am wondering if we have thought that this is often true figuratively as well as factually, and that possibly there might be contained in this statement a thought as to why certain steel fabricating plants have tried welding in their shops and have not found it to be economical.

These shops have developed crews especially trained in the various details of bolted and riveted fabrication. There is the corps of draftsmen who prepare the intricate details for connections—there are the templet makers who interpret these drawings and work up the layouts—there is the shop crew which cuts, drills, punches, assembles and rivets the various steel members—there is the inspector who is responsible for the correctness of all work leaving the plant and last, but by no means least, there is the supervising head of all these operations. Each of these is trained particularly for the duties he has been continuously called upon to perform.

No wonder there is difficulty when a new method is introduced—particularly one which is so different in every way. No wonder that all the way down the line everyone takes an undue amount of time preparing and fabricating welded construction—why they don't even know how to get started.

Truly such a concern finds, to their great sorrow, that "oil and water will not mix," at least not readily.

How much better it would be if those responsible for the introduction of electric welding into a steel fabricating plant, for the first time, would appreciate this fact before it is too late and would provide against any such trouble if the size of the plant permits, or if not, at least realize that such a new program will take time and patience to become economical.

The ideal arrangement, of course, is to retain the services of a properly qualified welding engineer who will make a thorough study of the existing conditions, make necessary recommendations for changes in routine, secure and qualify efficient welders, create a separate welding personnel, develop a proper welding procedure and train and put into operation an adequate system of inspection and approval of finished welds. This engineer's services should be engaged until such time as the new department is sufficiently trained to carry on the work economically and with security.

Where the size of the concern will not permit the introduction of such a new welding department steps should be taken for properly instructing and training those in control of the operation so that they will become familiar with all the advantages inherent in welding and will know just how to make the most of these advantages. They can, then, create their own welding personnel to take separate charge of all such operations.

Many concerns have thought they could save expense by experimenting along these lines themselves instead of spending good money hiring outside talent. This may have been true—and *was* true in most cases a few years ago—but this new art has advanced so rapidly, particularly during the last two years, that at the present time such is certainly not the case. There are a good many well-qualified welding engineers, whose services can be retained at nominal fees, who can, in a very few weeks, give a concern as much information and workable data as the company could accumulate, on its own initiative, in many months.

In either case, however, a concern should appreciate the truth of the statement that "oil and water will not mix" and not try to make those who are "riveted-minded" control and perform welding operations. The two operations are materially different and, to be handled economically, each operation should be carried on by a corps of workers particularly trained and experienced in that one line of work. If this is done, welding will be found to be a very useful and economical tool in the fabrication of structural steel—if not, it will unquestionably prove bothersome and expensive.

*Consulting Engineer, Manchester, N. H.

Split Steel Pulleys from Three Inches Up to Seventy-Two Inches in Diameter. Under Every Separating Load They Stay Put and Can Be Depended on for Every Service.

Pulleys That Stay Put*

By M. L. Eckman†

Rapid production of many sizes of pulleys, both light in weight and of ample strength is made possible by careful attention to design, the production sequence and metal shaping practice in conjunction with up-to-date resistance welding methods.

THE "Wheel" has been used from time immemorial in moving loads and transmitting power. Probably originated by some primitive man cutting a section from a tree trunk. In more modern times the "Wheel" has come to be termed a "Pulley" when used in transmitting power.

A narration of the development of the "Wheel" or "Pulley" from prehistoric times to the present would be a history of the mechanical and cultural progress of the human race.

In the three primary "Mechanical Powers", namely the lever, the pulley and the inclined plane, we note that in importance, the "Wheel" or "Pulley" ranks second only to the lever.

In ancient times the "Wheel" was known as an instrument of torture, but at present it has assumed high emblematic significance in civic and ethical ideals. The hub, radiating spokes and perfect circle rim reminds us of desirable social and moral attributes.

For twenty-five years the Barry Pulley Company, Inc., have been leaders in manufacturing equipment for the pearl button industry. This line includes tumbling barrels used for tumbling and polishing pearl buttons. Considerable difficulty was encountered in obtaining a pulley that would stand up under the incessant shock and reversal of strain loads on tumblers. So much so, that Mr. Nicholas Barry, a veritable genius in the development of pearl button machinery, determined to design a pulley that would withstand the varying conditions encountered. In 1915 they brought out the "Barry" tubular steel, welded, split pulley.

The distribution of the Barry steel split pulley to the four corners of the earth was made possible through the selling organization of R. & J. Dick Co., Inc.—manufacturers of "Dick's" Balata Belting who now own and operate the Barry Pulley Co. at Muscatine, Iowa, as a subsidiary company.

Careful inspection of this pulley shows that it is designed scientifically light in weight and yet amply strong where strength is required. This is made possible by electric resistance welding.

Many improvements have been inaugurated since the first product in 1915, but the three original outstanding features remain intact, namely:

1. Hexagonal Hub Principle
2. Tubular construction design
3. Assembly by Resistance Welding

Mr. W. M. Barclay, Vice President of the R. & J. Dick Co. states the use of special designed "Federal" Automatic Spot Welders has insured a sturdy, reliable product at low cost, one that stays put and does not loosen up or come apart through use.

A production of 400 complete pulleys per day is possible. Some 300 different pulleys are manufactured, varying in diameter, face and bore, from 3 inches to 72 inches

*The author calls attention to an interesting article descriptive of this same application of spot welding, which appears in the April issue of "Machinery."

†Research Engineer, The Federal Machine and Welder Co., Warren, Ohio.

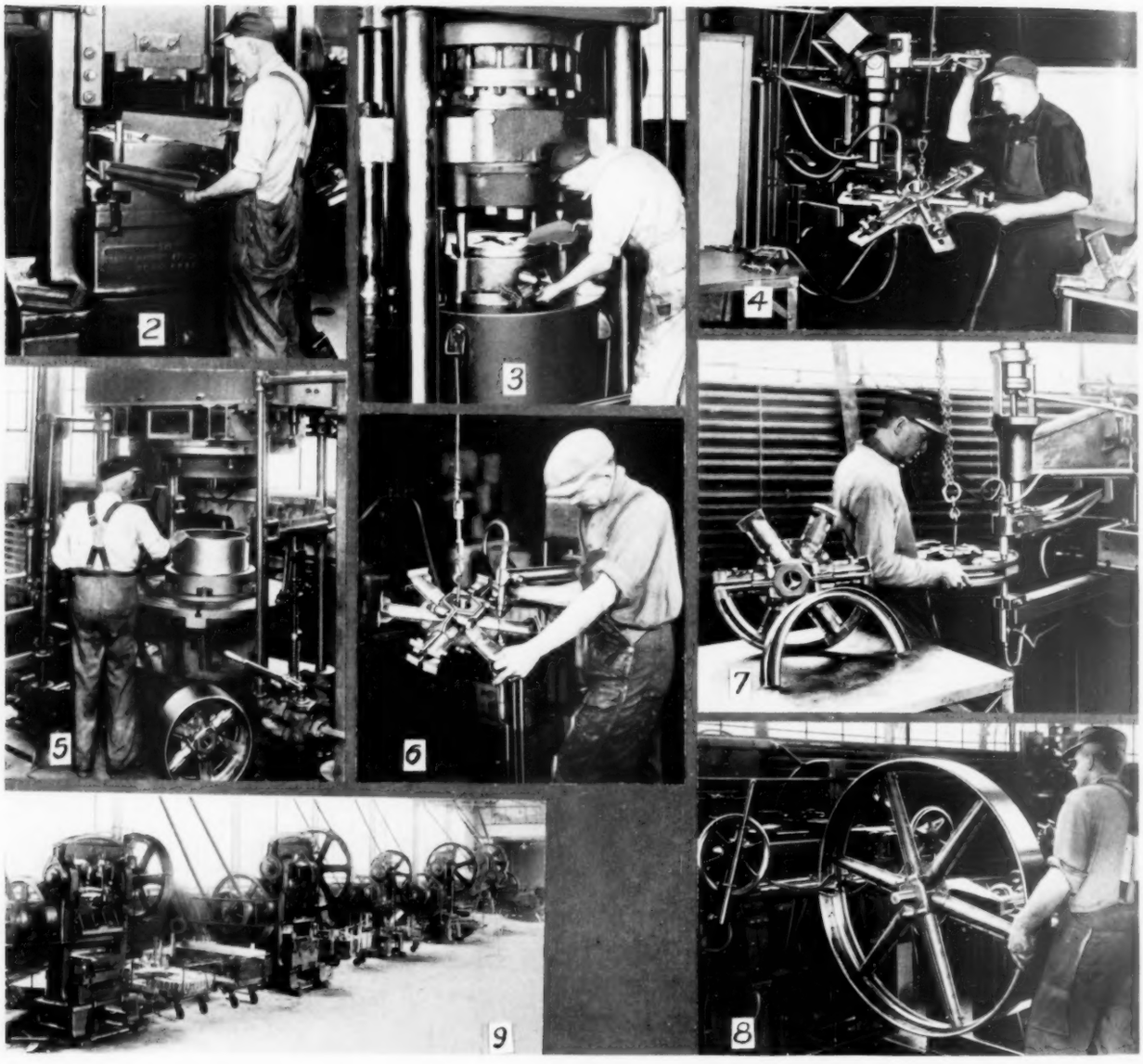


Figure 2. Forming Press Shapes Cut Blanks Quickly. Figure 3. Hubs for the Pulleys Are Drawn and Formed in Powerful Hydraulic Presses. Figure 4. Welding the Spoke to the Hub. Hubs, Half-Spokes and Quarter-Spokes Are Assembled on a Jig. Figure 5. Rolling the Edges of the Rims in Large Hydraulic Presses. Figure 6. Two Half-Pulleys Are Assembled on a Solid Bushing and Welded Together at Hubs and Along Edges of Spokes. Figure 7. Welding the U-shaped Rim Fillet to the Spokes. Figure 8. Welding Pulley Rim to the Spider. Figure 9. Line of Heavy Power Presses Used in Punching Blanks and Forming Parts.

diameter, in straight and crown face, and in width from 2 inches up. (Figure 1).

Figure 2 is a view down the production line, showing the heavy duty presses used in punching the blanks and forming some of the parts that go into the construction of the all welded pulley. The plant is planned and laid out for progressive production methods, stock moving logically from one operation to the next with a minimum of handling. Steel is bought in rolls or standard sheets, according to requirements, and careful planning and layout keeps waste to a minimum.

The press that forms the half-spoke is shown in Figure 3, the operator holding a blank and a finished half-spoke. On the base of the press will be noticed half-spokes for a smaller diameter pulley which are formed on the same die. Figure 4 is the powerful hydraulic press used to draw and form the hexagonal hub.

Figure 5 shows the quarter-spider assembly being welded in an aluminum fixture counterbalanced overhead in such a manner as to facilitate easy handling while loading, unloading or welding. At the right on the bench, notice an assembly from this fixture, two of which are welded at once. Forty welds per pulley.

Four quarter-spiders are assembled on a counterbalanced fixture to solid locating bushings, and spot welded along the hubs and along the edges of spokes. (Figure 6). Forty-two welds per pulley.

Figure 7 is a view of the welding of "U" shaped fillets to the spokes, concentrically, on locating fixture. At this point there are 20 series welds, making a total of 40 single welds.

An unusual feature of this operation is that a "series" weld is being made by means of the copper spacing block seen in the fillet between the welder points, so that a weld is made through one-quarter spoke and fillet and the current then travels through the copper block and welds

the opposite side of the fillet to the opposite quarter-spoke.

The double type automatic spot welder which indexes and automatically welds the fillet to the rim, both sides simultaneously, is shown in Figure 8. This machine is adjustable for different size pulleys.

The final operation before inspection is the curling of the rims in the powerful hydraulic press shown in Figure 9.

Summary: In a 36-inch diameter by 6-inch face pulley there are 36 formed steel parts electrically welded together to make a homogeneous unit. The actual time of jigging and welding does not exceed 15 minutes per pulley.

Inspection: Inspection is quite rigid and includes mounting each pulley individually on a master shaft and inspecting for alignment, concentricity, balance and strength. After passing inspection, they are painted and passed through the drying oven and ready for the stock room.

The stock room is a model of system and neatness and pulleys can be shipped immediately on receipt of order to any destination by package, carload.

The hub bushings are stocked separately according to size and each is interchangeable in any Barry pulley in its class.

The hexagonal outside diameter of the bushing which seats into the pulley hub together with the slots lengthwise of the inside diameter make a bushing that grips the shaft uniformly all the way around, a big improvement over former types.

The use of this hexagonal compressible bushing eliminates the necessity for keyseating, although keyseated bushings can be supplied. Bushings can also be supplied which have the key welded to form an integral unit; by this method the use of set screws is eliminated.

Bolts of the highest quality steel and threaded to S. A. E. Standard are used throughout. This practice was adopted after considerable research which proved conclusively their superiority over the regular standard bolts.

On account of the far flung distributing facilities of the R. & J. Dick Company, these pulleys may be called on to serve in the rubber plantations near the equator or may be put to work in the mines of Alaska or Siberia, and after fifteen years of service under all kinds of conditions and climates, are doing their share of the world's industry with credit.

Training Welders in England

Over thirty students from the Army Vocational Training Center, Aldershot, England, visited the Ferry Lane Works of Murex Welding Processes Limited to witness demonstrations in Electric Arc Welding.

In additional to the demonstrations which were given in connection with the various processes of welding, the students attended lectures on Elementary Metallurgy, and also on the fabrication of all welded steel structural buildings. The Army Vocational Training Center, Aldershot is engaged in very important National work, training N. C. Os and men who are about to leave the Army to return to civil life so that they will have a good knowledge of a definite trade or calling.

A course in Welding at the Center was introduced in 1927 when the equipment only consisted of one Electric Welding Generator and one Oxy-Acetylene Welding Set, but since the course has proved so very successful, continuous progress, and development has taken place, and the numbers have now reached sixty students, and three instructors. The increased number of students has necessitated an increase of equipment, and Murex Welding Processes Ltd., have recently completed a contract to install a transformer set for six welders, which when complete will bring the total of Electric Welding Equipment up one D. C. and six A. C. Electric Arc Welding Plants.

The question of securing employment for each student receives special attention by the center employment Bureau, and efforts are continued until the students gets work. The Ministry of Labour Employment Exchanges and the National Association for employment of Regular Sailors, Soldiers and Airmen also assist. After leaving the center the student keeps in touch through the "Old Students Association," and assistance and advice is given from time to time to any student moving on to new work. Since the formation of the center on the 1st. April, 1927, 208 men have completed a course in welding and 162 have obtained work in the welding trade.

Over Half of Buffalo Show Space Already Reserved

Announcement received from the American Society for Steel Treating states that space assignments cover 53 per cent of all available exhibit locations at the Fourteenth Annual National Metal Exposition to be held in Buffalo during the week of October 3rd.

Keeping pace with the Exposition plans, the technical program of the National Metal Congress is also nearing completion. Plans this year call for nine technical sessions with about three papers to be presented at each session in order to allow more time for written and oral discussion.

An important part in the 1932 National Metal Congress Exposition will be played by firms and individuals connected with wire manufacture. The Wire Association will have a series of meetings as part of the Congress, while a number of manufacturers of wire and wire drawing equipment have reserved space in the Exposition. Technical sessions will also be held by the American Welding Society and the other engineering organizations who have participated in previous years in this big national event.

This will be the second time that the welding fraternity has held forth at Buffalo for its annual meetings and display of welding equipment and welding materials. The city has splendid facilities for entertainment of visitors and it is centrally located in a district which includes many of the largest metal working industries of the country. There is an active, progressive group in the local section of the American Welding Society which can be counted upon to make adequate preparations for a successful show as far as the welding industry is concerned.

Sheet Welding In Production*

By Earl Kelsey†

All the sound advantages of oxy-acetylene welding can be obtained easily if the fundamental requirements are closely adhered to. The author points out how procedure control is applied in sheet metal production.

IN sheet metal utensils that are designed to contain liquids, tightness and smoothness are necessary qualities, especially in hospital and kitchen ware. Oxy-acetylene welding was early found to be the only satisfactory method for producing joints in sheet metal utensils that were to have these properties, particularly when they were to be subsequently covered with porcelain enamel. A less substantial joint than a gas weld eventually would mean the breaking or chipping away of the enamel and exposure of the raw steel underneath. The resulting corrosion of this exposed metal would then produce an unsanitary condition. Here again welding made possible a vastly improved product, and greatly simplified production.

Design of Welded Joints

It is a matter of experience that when the welding process is employed, important advantages are secured in simplifying such features of the work as the design, layout, trimming of the metal, and matching the adjoining members as well as the actual joining of the edges. In the manufacture of utensils, the butt type joint or a variation thereof is used almost exclusively, since one of the principal reasons for using welding is to eliminate the lap joint. A modification of the butt joint particularly useful and to be preferred on sheet thinner than 20-gauge is the flanged joint. As the name implies, the edges are flanged and the upstanding, quite narrow faces of the flanges are brought into contact. Welding is then carried on by fusing down and together the projecting flanged edges; welding rod is seldom used. Inside or outside corner welds must sometimes be made. For inside corner welds, essentially a butt weld, an even fillet can be readily produced and very little finishing is ever necessary to provide a smooth appearance.

As mentioned before, the butt joint is particularly advantageous when the finished article is to be enameled. The weld metal will "take" the enamel just as well as the sheet. There is no cracking at the joints, due to the expansion or contraction. Enamel will adhere to oxy-acetylene welds smoothly and evenly, eliminating the "shivering" that is often seen in other types of seams which are less rigid joints made by certain other processes. Since the joints are the most critical part of enameled utensils from the standpoint of sanitation, the importance of this point can be readily appreciated.

The quality of the sheet used has considerable bearing upon the success of the enameling as well as upon the success of the weld. Sheet must be of a quality suitable for both enameling and also for welding. It is advisable to include the factor of weldability in the specifications for sheet that is to be used in the fabrication of any welded product. As a check, it is sometimes desirable to give each new batch of sheet that comes into the plant a weld test before fabrication is commenced.

Importance of Properly Designed Jigs

Many welding operations in production are facilitated by work-holding devices and special tools called jigs or fixtures. Some operations which might not otherwise be possible are rapidly and efficiently accomplished by the use of carefully designed auxiliary appliances. Profits derived from an operation are often greatly increased by the savings in labor, time and handling thus made possible.

Jigs are utilized in production welding for four major purposes; convenience, economy, quality, and speed. These factors overlap to a great extent, and by the use of properly designed and constructed jigs, all these advantages will be obtained—notably in the production of large numbers of similar parts.

Possibly all of the advantages of the use of jigs in welding operations can be summed up in the term "standardization." This standardization of practice, an outcome of the effective employment of jigs, results in greater convenience in handling production welding, as well as greater uniformity and accuracy in the finished product.

Giving the operator facilities for handling his work as easily and conveniently as possible has produced far greater results than simply increasing the speed of the operation and reducing its cost. Improvement is also reflected in the quality of the work, in the morale of the worker, and in economy of welding supplies and gases.

It should be readily evident that the use of jigs will cut down costs, especially when the welding is being done on a production basis. Jigs can usually be loaded and unloaded by helpers, or two welders can work alternately at welding and helping, keeping the equipment in constant and efficient use.

Fitting and complicated setting-up are automatically eliminated when jigs are used. The time previously necessary for this work is saved and often it is possible to use less skilled labor or apprentice welders for the set-up and tacking operations.

Another purpose of jigs and fixtures is to control or direct the expansion and contraction that is always to be expected and allowed for in welding light gauge metal. Two primary principles are involved, namely: restricting the movement of the parts during welding so the expansion and contraction will be confined to an even, narrow zone near the weld and second, conducting the heat out of the thin metal into the relatively bulky sections of the jigs. Proper attention to the second factor will eliminate a great amount of the expansion and contraction that would ordi-

*From a paper presented at Purdue University Welding Conference, Lafayette, Indiana, December 11, 1931.

†Columbian Stamping and Enameling Co., Terre Haute, Ind.

narily take place. Many types of jigs are employed for this purpose. They may simply be heavy bar iron or old rails placed parallel to the seam which, by their weight, will retard or restrict the movement of the sheet due to the heat of welding. Such a simple arrangement often is developed in production work to an elaborate set of jaws or a clamping mechanism such as commonly used for welding barrels and tanks. Other jigs, especially designed for welding together pressed sheet metal parts, may be so constructed that the heat will be confined to a very narrow area near the seam and at the same time act automatically as a gauge or mold so that there will be no difficulty because of incorrect positioning of the parts. This assures finished products that are uniform in shape, an especially important feature when parts are later to be assembled into a larger unit.

Typical Example of Use of Jigs

The welding of a special type of hospital receptacle in highly developed jigs will serve to illustrate the application of these principles. The utensil is made of two circular pieces of formed sheet metal, the upper and lower half sections of which are formed with edges slightly flanged. The width of the flange is approximately twice the thickness of the sheet which is 25-gauge black iron.

The first step in fabricating the receptacle is tack-welding the two half sections. The two operators work together at a swinging jig, equipped with two holders. The jig is power-driven and revolves the holders through a complete circle, exposing the flanged edges at the angle most convenient for the welding operator. Speed of rotation is controlled by a pedal lever. The two sections are tacked-welded at 12 points, the flame being applied through slots provided in the holder. The two operators alternate as welder and helper at occasional intervals. The helper assembles the two sections of a receptacle, clamping them tightly in place in one of the holders while the welding operator tack welds the piece in the other holder. The helper then swings the jig so as to bring the parts just clamped in the holder into position in front of the welder. The tacking operation is then repeated without lost time or motion. Meanwhile the helper unloads and reloads the jig. Two operators can turn out a surprising quantity of work in an hour.

The welding is performed in a jig of another design, which also is power driven at a speed controlled by the welder. A very small amount of welding rod is used in welding the seam. The jig revolves the line of weld before the welding torch, so the operator can do practically all the welding without change in position. Working together and alternating at intervals, two operators handle this operation, one welding while the other loads and unloads. They are able to turn out almost one-third as many pieces as the operators doing the tack-welding, so perfectly coordinated in this operation.

Welding Technique

There are three major factors to be provided for in producing satisfactory welded joints. First, distortion must be avoided; second, complete fusion to the inside of the joint must be secured; and third, the surface contour of the weld must conform to what is desired for the particular joint. If the weld is to be ground flush with the sheet, reinforcement should be as little as possible. When inside corner welds are to be produced, concave fillets of good appearance should be made so that very little grinding will be required in the preparation of the utensil for enameling.

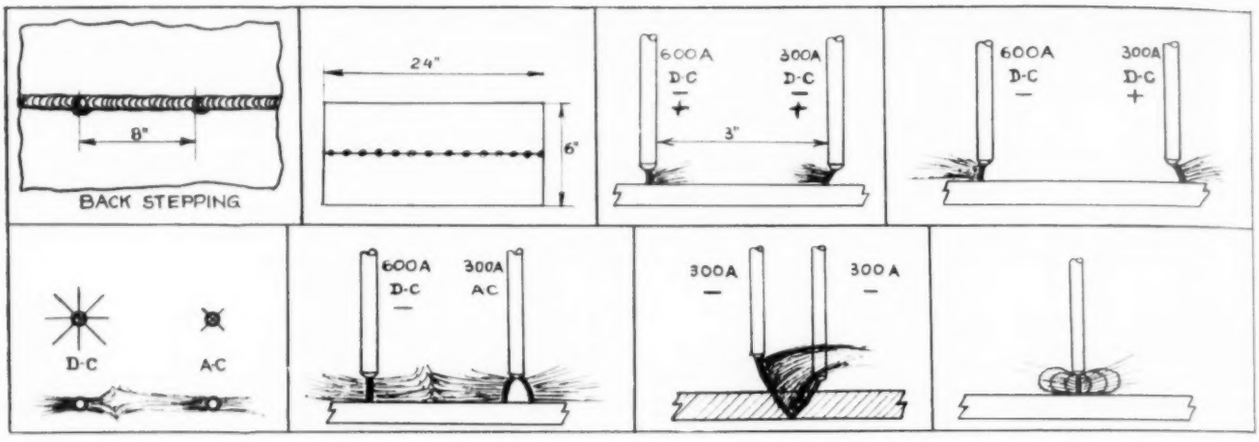
Expansion and contraction caused by the welding heat are taken care of chiefly in the design of the article, by the use of correctly designed jigs and by the manner in which the tacking is done. However the proper performance of the welding operation will have its effect on eliminating unnecessary distortion. The amount of heat to be absorbed by the sheet metal or the jig should be kept to a minimum consistent with a reasonable rate of welding. Sometimes the use of a larger welding tip will not only increase the welding speed but will also minimize the absorption of heat; brief experimentation will generally give an indication as to the proper rate for best results.

It is important that fusion be made to the inside of the joint when the weld is to be finished by grinding to the surface level of the sheet. To secure this, there are several variations of the general welding technique that can be used with equally good results, but even if supervisors are able to observe the welding of the different operators from time to time, occasional joints should be checked to see if the desired penetration has been secured. A good non-destructive test for the welding supervisor is one in which he heats up the seam along one side of the weld to a bright red. If a sound, fully penetrated weld has been made, an even heat color will be produced on the other side of the weld, but if the weld is imperfect, heat transfer through the joint will be uneven and will be indicated by varying intensities of color. The welding supervisor can also melt out and reweld any section of a joint he desires as another way of checking weld quality and penetration. If these tests are apt to affect the finished appearance of the article, other means of checking the welders should be employed.

Forehand welding technique is customarily used for sheet metal welding since the finished appearance of welds is better when this method is used. For certain types of welds, however, particularly on heavier sheet, backhand welding may be found preferable. Since the size of welding rod and tip depends on the technique used, skill of the welder, type of joint, character of the welding jig, and methods of tacking, definite rules cannot be set and sizes must usually be determined by experience. However, 1/16 in. rod is generally used in welding sheet up to 1/16 in. in thickness and 3/32 in. rod for metal up to 1/8 in. in thickness.

Short welds in light sheet can often be satisfactorily finished by filing. Grinding should be used for the longer welds because a greater production can be secured. Specially shaped grinder wheels will often speed up the work and produce a neater and smoother finish. Where the welding has been carefully done, little effort will be necessary to put the weld into such condition that it will not show after the welded article has been enameled.

When products are to be enameled, testing is best done after the grinding operation. Cylinders, tanks and similar vessels are tested by closing all openings and subjecting the vessel to air or water pressure. If air pressure is used, soapy water can be employed to good advantage in locating leaks. Open vessels can be tested by filling them with water and inspecting the outer surfaces of the weld for wet spots. Kerosene is often used in place of water as this liquid will seep through more quickly if a pin hole or small fissure happens to be present.



Above: Figures 17, 18, 19 and 20. Below: Figures 21, 22, 24 and 25.

Methods of Controlling Arc Blow

By R. W. Holt

In concluding his discussion on methods of controlling arc blow, the author points out further practical ideas in correcting this annoying condition in arc welding.

ANOTHER method of controlling arc magnetism, which is probably more generally used than any other, is welding six to nine or ten inches of seam and then stepping back approximately the same distance and welding towards this first section of welding. This is commonly called "back-stepping" and is simply working with the arc magnetism; in other words, traveling in the direction that the arc tends to go. It is probably the most generally used method of controlling arc magnetism. (Figure 17.)

Tacking

In special cases tacking is an effective control. The average mistake of the welder when he attempts to use tacking to overcome arc magnetism is that he does not place the tacks close enough together and, as a rule, makes them heavier than necessary. The tacks should be approximately two inches apart on the average job, and very light. (Figure 18.) They can be made by using a heavier current than would be used for welding the same article, quickly making one tack, raising the arc a little bit long and walking it to the position of the second tack, and so on to the third, fourth, and continuing down the seam.

Summing up the control of arc magnetism or arc blow for hand welding, the recommendations would seem to be about as follows. First, weld in the regular manner if the arc magnetism is not too bothersome. Second, tilting the electrode. Third, placing the ground at the best possible point, especially when the ground is placed more or less remote from the welding. Fourth, attach the ground cable to a weight made of a plate of iron with a handle for conveniently handling it, and having on its end a single contact so that connection to the actual plate or grounding to the actual article being welded may be made, and using this as a means of grounding very close to the arc and controlling its blow on flat surfaces. Fifth, the use of a narrow strip of metal $\frac{3}{8}$"x1$\frac{1}{2}$"x8" attached to the ground cable and held in the left hand. It is better if this narrow strip of metal has an insulated handle. This is especially useful on vertical surfaces. In addition to being held in the left hand, it can also be tacked very readily with the arc at various points on vertical surfaces. Sixth, and last, small tacks spaced about an inch or so apart. This last, however, should be avoided wherever possible because it is extra work. Note that the summary of controlling arc magnetism in hand welding is arranged in such a manner or order that the most convenient ways, or easiest ways, of controlling arc magnetism are given first. The succeeding ways should be used when the difficulty becomes worse on different jobs.

Arc Blow in Automatic Welding

Some particularly bad magnetism is generally encountered when trying to run two arcs very close together, especially if the arcs are within two, three or four inches of each other. There are two things causing this magnetism. First, the natural inherent magnetism of the pieces being welded in attracting the arc in a certain direction. Second, the attraction or repulsion of the arcs for each other. Our discussion in hand welding has pretty well covered the natural magnetism of the pieces being welded and practically everything discussed holds good for auto-

matic welding. The control principles hold good wherever it is possible to use them.

To understand the attraction or repulsion of the arcs for each other, let us think back to the picture of two ordinary conductors carrying a current, and compare this picture with two arcs running side by side. Two coils carrying a current are simply two magnets and they will have an attraction or repulsion for each other when brought close together, depending on the direction of the current flowing in them. Two conductors are simply two parts of two coils and they have the same attraction or repulsion for each other only in a weaker degree. The arcs are simply two conductors, but the arc flame and arc proper is free to move to a limited extent. While this explains the cause of the movement, we are interested in knowing, "What direction will the movement take, and how strong it will be?"

Two Direct Current Arcs

The best way to do this is simply to set two arcs down side by side and observe their movement, when the polarity is the same and also when the polarity is different. By this experiment we find that when two arcs are approximately three inches apart and the polarity of the electrode is negative, they will attract each other. They will also attract each other when the electrodes are positive. (Figure 19). When the polarity of the two electrodes is different, however, they repel each other. (Figure 20). From this we note that two arcs of the same polarity, side by side, will tend to blow toward each other, while if the polarity is different, they will blow away from each other. That leaves us the question of alternating current to answer.

Alternating Currents

Running a light alternating current arc alongside of a heavy direct current arc, approximately 400 amps in the direct current and 200 amps in the alternating current, we find the blow divided. There is just as much commotion, but the arc flame is extended in both directions, away from the respective arcs. The direct current arc is also affected the same way. (Figure 21).

On viewing from the side closely, it appears that the alternating current arc has actually divided itself into two arcs, one going away and one toward the direct current arc and this is exactly what happens, half the time it blows towards the direct current arc and half the time away, and two A.C. arcs side by side would obey the same laws of the direct current arc. In other words, they would blow toward or away from each other, depending on whether their signs were plus or minus at the same instant or not. (Figure 22).

Two Arcs of Like Polarity

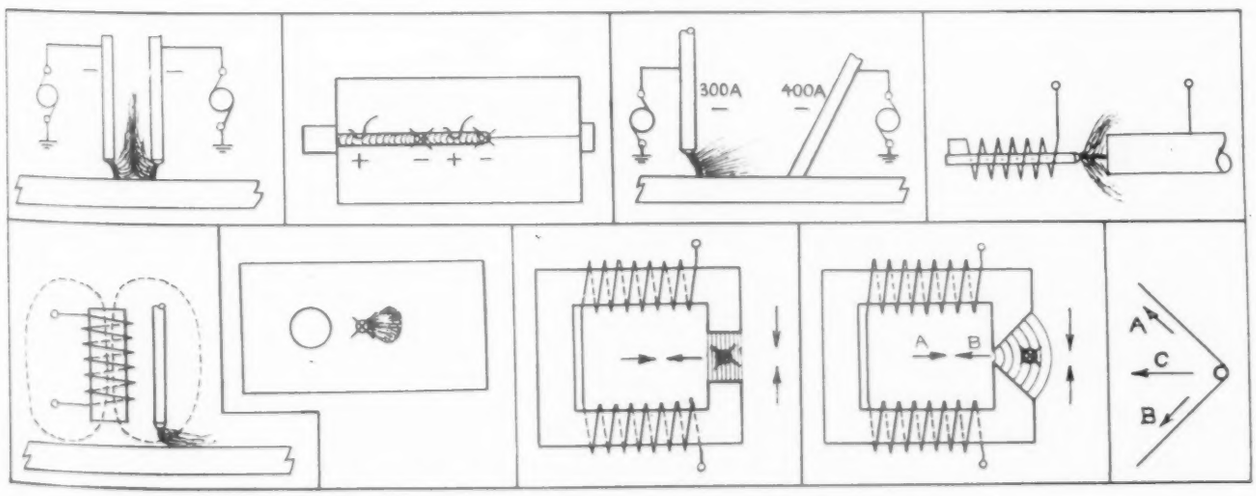
There is a curious phenomena that goes on when we bring two direct current arcs close together, of the same polarity. The blow is toward each other, but the arc flame will not intermingle when the arcs are brought quite close together. On meeting, however, the arc flames change their direction very similar to the change that would take place if two streams of water were directed towards each other. In other words, they seem to collide and find the easiest way out, in this case, upward. (Figure 26).

A puzzling question might be asked here, why will not the flames of two different arcs intermingle or mix? If one arc is longer than another when the two are side by side, and of the same polarity, the longer arc will overpower the flame of the shorter arc, resulting in a blow in one direction. (Figure 24).

The first case to be considered will be the case of running two arcs side by side. It is more or less impossible to apply a control that will overcome the magnetism of the two arcs for each other. In other words, the tendency to move towards each other. Therefore, the best plan is to separate the two arcs, and apply a separate control to each arc. This separation should be at least eight inches, and from this point on the discussion will take up fundamentals of control of individual arcs, it being taken for granted that the principles can be applied to a double or multiple arc system.

Sliding Ground

To a certain extent, the ground can be used to control arc blow in automatic welding when placed at remote places on the work. To be really effective, it would have to be brought quite close to the arc and slid along behind the arc when welding more or less uniform pieces. In the case of two arcs working along the same seam, each arc would have to have its individual ground sliding along behind it. Due to the fact that the second arc is somewhat nearer the magnetic center of the pieces being weld-



Above: Figures 26, 27, 28 and 30. Below: Figures 31, 32, 33, 34 and 35.

ed, it is not affected by the natural magnetism of the pieces as much as the first arc. For this reason, its ground would be somewhat farther away to the rear, (Figure 27). This system may be open to the objection that sliding contact is made on the hot bead and also there would probably be complications at the start of the weld. One of the most effective ways of controlling arc magnetism in automatic welding, mentioned here more for its scientific interest than for its practical use, is a carbon brush carrying at least as much current as the arc approximately an inch to three inches or more in front of the arc of the same polarity. Varying the distance between the carbon brush and the arc varies the intensity of the correction or control applied to the arc. This is one of the most effective and quietest means of controlling the arc the writer has seen, but is open to serious objections from a practical standpoint, namely the use of an extra source of current supply, (Figure 28).

Magnet Coils and Magnets

Another way of controlling the arc is to wind a magnet coil around the electrode and pass more or less of the welding current through this coil. Here again, the arc will tend to move in such a way so as to provide the greatest space for the magnetic lines of force resulting from the current in the arc flame and arc proper. This means moving from the congested field of magnetism towards the part that is less congested and in this case it would be a movement directly away from the coil, and such is found to be the case, (Figure 30). A simple bar magnet held vertical to the electrode and brought fairly close to it can be used to push the arc around very nicely. A piece of iron approximately one inch in diameter and ten inches long can be used for the magnet, wrapping a coil around it and shunting more or less of the welding current through it, by a resistance shunt, holding the bar magnet approximately three or four inches away from the electrode and approximately half an inch to an inch off the surface of the plates being welded. The resistance shunt for varying the amount of current that flows through the bar magnet is not shown in Figure 31 which illustrates this principle. Two bar magnets can be used, one on each side of the arc to throw it forward and back, depending on whether current is passed through the one ahead or behind the arc. Care must be taken, however, in using two bar magnets to see that they are the same polarity, both south or both north poles of the bar magnet towards the plate. When switching the arc around in this manner with a bar magnet, it tends also to spread the arc a certain amount, (Figure 32).

Influence of Cross Magnetic Field

Still another method of overcoming arc magnetism or arc blow is to pass a magnetic field through the arc while it is at work of uniform intensity. The arc will tend to move across the magnetic lines of force of the magnet. Reversing the lines of force or the current in the magnet causes a reversal of the arc's tendency to move. An ordinary two-pole electric magnet can be used to illustrate this principle, (Figure 33). This cross magnetic field can be caused in other ways than by using a magnet, such as a conductor lying along in back of the sheet, carrying a heavy current. If the pole pieces of the magnet are cut at a slant (Figure 34), it will result in the magnetic lines of force taking a curved path and, when the arc is urged along in the direction taken or shown by Arrow "B," Figure 34, the arc is held steadier in place and does not tend to jump sideways so much as when a straight crosswise magnetic field is used. The effect is much the same as when an attempt is made to pull a weight along on a smooth surface by a string looped around it, (Figure 35), "A" and "B" being the arrows showing the tension on the string and "C" the direction of movement. The tendency of the weight is to move directly along the line shown by Arrow "C" and scarcely moved sideways at all, but to move very steady along the line shown by Arrow "C."

Gas Welding and Cutting in Transportation*

THE revolutionary changes that have taken place on steam railroads during the past decade as a result of loss of passenger and freight revenue, which condition has increased in the past year from the general business situation, has resulted in a severe reduction of maintenance forces, reduction of working hours, and finally reduction of appropriations for new development and of expenditures for maintenance of equipment. This situation is reflected in improved operating methods, reduction in personnel, and economies of repairs and maintenance, thereby demanding a true regard for the possibilities and value of the oxy-acetylene process to compensate for the reduced buying power, in both reclamation and the manufacture of many parts of locomotives and cars heretofore not considered practical.

Cylinders

Officials are now constantly on the alert to further reduce operating costs. The oxy-acetylene process has played a very important part in this program by reducing cost and labor over previous methods of performing repairs on locomotives, cars, and other equipment. It has introduced such operations as the bronze welding of broken locomotive cylinders with a tremendous saving to the railroad. Broken cylinders are welded in place and the locomotive placed in service without the loss of time necessary for removing them on account of the fact that it is not necessary to preheat to the extent which was necessary when using castiron.

Piston Heads

Another major operation which has been introduced on the railroads is that of building up locomotive piston heads with manganese bronze. A total of 2,213 heads were reclaimed by one railroad with this process. An important feature of this process is the reduced wear on the cylinder bushings resulting from the bronze surface of the head. Service tests have proven that a piston head built up with bronze will outwear approximately three of the regular cast iron heads and this operation can be done at 50 per cent less cost than that of applying a new head.

Frames

The welding of broken locomotive frames by the oxy-acetylene process is standard practice on the majority of railroads. In former years before the introduction of this method of frame welding, it was necessary to remove the frame from the locomotive and take it to the forge shop for repairs which meant a large amount of time and was costly. Today broken locomotive frames

*From the 1931 *Report of the Oxy-Acetylene Committee of the International Acetylene Association.*

are being welded in place eliminating all time and cost of removal. When the oxy-acetylene process was first introduced on this class of work, it was common practice to consume from four to five hours on an average frame but today, the larger size frames are being welded in from one and a half to two hours. This is the result of improved methods, such as equipment, procedure, improved rod, etc. A record has been kept by one railroad over a period of several years on frame failures on locomotives which gives the locomotive number, location of the failure and if it is a new break or a failure to a weld. The percentage of weld failures has been approximately 1 per cent.

Many of the larger railroads have with the aid of automatic shape-cutting machines and the welding torch fabricated complete locomotive frames, including front breast beams, cross ties, brake hangers, rear decks, etc. The first costs of such welded frames were comparable in every way to former methods of manufacture. However, in such cases the real savings effected are by the complete elimination of maintenance of all connections and splice bolts, including bolted brackets, etc.

New Operations

Many new operations have been established both in the locomotive and car departments. Suffice it to mention some of the major operations in the locomotive department, such as the welding of worn valve motion parts, worn spring rigging, worn driving box equalizers, broken spokes in driving wheels, broken wheel centers, worn booster parts, feed water heater parts, train control, air brake parts, lubricators, injectors, worn guides, worn or galled main and side rods, crossheads, crosshead shoes, air piping on locomotives, and superheater units. In the car department may be mentioned the welding of journal boxes, truck pedestals, collars on axles, equalizer bars, draft gear parts, worn couplers, worn coupler knuckles, air brake parts, air piping, steel center sills, bolsters, truck side frames, passenger car roof sheets, side sheets and end patches. In addition to locomotives and car oxy-acetylene welding repairs are also made to machines, machine parts, tools, power house machinery and boilers, maintenance of way machinery, ditchers, clam shells, pile drivers, motor cars, gas-electric equipment and interlocking equipment.

Cabs and Cars

The welding of locomotive cabs has proven to be most successful, making them stronger and increasing their service due to rigidity and elimination of corrosion which usually occurs in riveted or bolted joints.

Many railroads have adopted as standard practice the welding of air lines, steam heating lines and radiators in various types of cars. One of these roads reports welding to date on the following number of cars:

1,112	High side gondola cars
946	Low side gondola cars
61	Baggage cars
15	Baggage and mail cars
70	Passenger cars
24	Smoking cars
12	Dining cars
406	Box cars
15	Coke cars
12	Electric engines
108	Engine tenders
316	Steam coils for engines and cars
3,822	Total

The adoption of the welding of these lines was prompted for the following reasons: (a) the elimination of threads on pipe gives an increased strength of 50 per cent; (b) the hazard of broken pipe is eliminated; (c) the maintenance of leaky joints is eliminated; (d) there is complete saving of pipe fittings and a resultant reduction of pipe fittings carried in storehouse stock, and (e) there is a great saving in labor in assembling piping.

The advancement of the motor coaches and motor rail cars—both gas and gas-electric—has grown so great that the railroads to keep step have had to establish welding departments to meet the demands. Welding operations in this department consisting of castings, gear cases, crank cases, built up piston seats, etc., all effecting a great saving over replacement by new parts.

Cutting

The use of the cutting process in conjunction with automatic shape cutting machines has been found to be most useful and important in the manufacture of parts for locomotives, cars, coaches and maintenance-of-way requirements. The cutting to shape particularly of locomotive main rods, side rods, equalizers, combination levers, radius bars, links, and many other parts formerly shaped from heavy billets under the steam hammer necessitating a large amount of machine work, is now reduced to the lowest possible minimum, as ordinarily only finishing cuts are required to make these parts serviceable.

The cutting process is also used extensively in all departments and has increased repair work to a marked degree. Of the many applications to the locomotive may be listed such operations as the removal of old fireboxes, bevelling and cutting to size of sheets, cutting out radial and staybolts, rivets, flues, etc. These parts were formerly drilled or cut out by tools and sledge. The removal of rivet heads, formerly a slow and laborious process, has been reduced to a simple and quick operation by the introduction of special recently-developed rivet cutting nozzles, thereby reducing the time from days to one of hours. In the stripping of locomotives for repairs, the use of the cutting blowpipe has been an important factor in the removal of cylinder and frame bolts, brackets and studs in inaccessible places and parts formerly drilled or removed with hand tools and sledges.

In the car department, a similar program is carried out on cars undergoing heavy repairs. Car bodies are first stripped by cutting off all rivets and bolts. In the case of steel cars defective sheets are also cut out. Throughout the freight and passenger car departments the cutting process is used to a large extent in reducing costs and expediting the repairs.

Accumulations of large tonnages of ordinary scrap on all railroads have always been a serious problem from the standpoint of handling and disposal. This problem has been materially increased due to the obsolescence of many hundreds of locomotives and thousands of cars in the past five years. The increased value of classified scrap cut to charging box size has netted a tremendous profit to railroads who have used the cutting blowpipe to the fullest advantage for demolition of such equipment as compared to the previous practice of selling all such equipment on wheels.

Many economies, with resultant reduction in labor and saving of time, are effected in the maintenance-of-way and bridge building departments. There the welding and cutting processes are used extensively in extending the life of rails by the restoration of the worn rail ends, worn

wing rails and points on frogs, worn crossovers, worn switch points, and the application of switch point protectors. These practices have been established almost universally and have resulted in large savings, particularly during the present time when the purchase of new rail has been reduced to the lowest possible minimum.

Pipe Welding

The elimination of flanges and screwed joints in the installation of power house piping, gas, water and steam lines and about shop premises, has influenced increasing applications of welding, and the control of welding technique in recent years has contributed materially to the progress made in the installation of such pipe lines. The advantages of welded joints over previous methods has reduced maintenance and made possible a lower cost of installation for high pressure lines. When consideration is given to the distribution of costs on a piping installation, which is approximately 10 per cent for pipe, 56 per cent for valves, fittings, flanges, hangers, bolts and gaskets, 17 per cent for shop work, erection, and supervision, 10 per cent for pipe covering, and 7 per cent for overhead, freight, profit and miscellaneous, the resultant saving by the elimination of the fittings, flanges, etc., is quite obvious.

In the electric street railway field where, due to their peculiar status in the social and economic order, efficiency in management and operation is a prime necessity, unsound practices have been largely overcome and real strides toward idealistic welding practices are being made. Ninety-four per cent of all electric street railways use the oxy-acetylene welding and cutting process. A recent survey of 35 typical companies revealed that 57 per cent use it for both maintenance-of-way and shop work, and that the remaining 43 per cent use it for either one or the other of these operations.

In the rolling stock or motive power departments, repairs to damaged, worn, defective, and obsolete parts are made with the process, and care is exercised that only the most efficient practices are followed. Journal boxes, pedestals, brake rods, drawbar shanks, suspension bars, hangers, brackets, journal brasses, and the like are being economically reclaimed with the welding intelligently planned. Hard and soft bronzes, low and high carbon and manganese steels, and hard surfacing materials are employed, depending on the use to which the welded member is to be put and the strain to which it will be subjected. Repairs to car bodies, trucks, bumpers, and frames are made by welding, while the heating and cutting properties of the process are used in the straightening of bent members, in the removal of dents, defective parts, rivets, bolts and the like, and in the demolition and scrapping of obsolete and totally damaged members.

Ways and Structures

The use of the process in the way and structures department has paralleled and even surpassed its use in repair shops and plants. Here, it has proven an indispensable adjunct in the repair and maintenance of trackways, and welding, cutting and heating units are being supplied in ever increasing quantities. The simplicity of operation after a short period of instruction, the ease of portability, and the speed of operation, are all factors contributing to its ever increasing use, and today it ranks with the hammer, chisel, wrench, and the like as a most necessary tool. In addition to the regular track work in this department, the application of rail bonds with special copper-alloy filler rod, which is of high strength and high electrical conductivity, is performed with this process. Also it has been used advantageously in reclaiming corroded metal street poles which were weakened at the base.

As the electric street railways are branching out into the bus and other methods of transportation, their facilities for the repair and storage of these vehicles are growing accordingly. Well equipped garages and repair shops are being supplied for these purposes, and here the welding and cutting unit has proven indispensable. It is used in the welding and cutting of broken brackets, hangers, etc., in the repair of damaged gasoline engines, in the patching and straightening of bodies, frames, axles, worn seats, door and other parts, and, as in the car departments, in the repair of practically all metal parts.

Power Plants

The modern street railways company, besides being a system of transportation, has as a rule auxiliary interests which, in some instances, overshadow the transportation end of the business. These include power plants for the manufacture of the electric power necessary for transportation; heating plants for the group; heating of public and private buildings; hydro-electric plants for the generation of power both for public and private consumption; plants for the manufacture and repair of electric furnaces, refrigerators, etc. All of these, together with the others used only for transportation purposes, are potential and actual exhibits of the growth of the process in this industry. In the building of the structures, the use of welded pipe lines is showing an ever increasing development. In the maintenance thereof, the welding and cutting unit has assumed major importance. From the central heating plants, vast networks of welded pipe lines are stretching in ever widening circles throughout the cities, buried in tunnels and conduits where perfection in welding is a necessity. In the hydro-electric plants, where breakdowns are ultra-expensive, the welding unit is proving a real insurance factor, and in the plants devoted to the electrical devices, such as furnaces, refrigerators, and the like, where special alloys are the rule rather than the exception, intelligent and indispensable use of the process is being made.

NEW BRIDGE FLOOR IS WELDED

In the construction of the new Boston Bridge near Pittsburgh an improved flooring was used. It was made up of sections of T-Tri-Lok, a Carnegie Steel Company product which makes possible a saving of half the weight of the usual bridge floor. It was installed, fastened to the bridge girders by arc welding. Photo by Westinghouse Electric & Mfg. Co.

Building a Job Welding Business

By W. Irving Brockson

XI—The Necessity of Sound Bookkeeping

GOOD bookkeeping is essential to the success of any business. Despite all the progress made during the last quarter of a century in accounting methods, mechanical bookkeeping devices, simplified record systems, etc., authorities tell us that faulty bookkeeping and neglect or ignorance in operating and handling financial records still make up one of the important general reasons for business failures.

"I hate that d - - - figuring", is an expression very frequently used by men who operate their own companies. The man who has been a welder, a foreman, a superintendent or a shop operator of any kind is more likely to be of that temperament than the man whose experience has been gained in other branches of business.

Most assuredly the owner of a welding company will not want to tie himself down to the details of doing all the bookkeeping for his place. However, it is important that he *know how* to do it should necessity arise. In addition to being familiar with the mechanical operation of whatever record keeping system may be installed in his establishment, the owner needs to be able to interpret the meaning of the various totals, summaries and statements which are available periodically, and to appreciate what each summarized figure means with reference to profit and loss, to progress or the lack of it.

The Desirability of Simplicity

"The success of any record or book keeping system is in proportion to its simplicity." Whoever first made that statement "said a mouthful." Some companies are loaded up with extensive and complicated methods of accounting which require "three men and a boy" to arrive at essentially the same results that should be obtained through the efforts of one man. This is no fault of accounting in general but it is an evidence of poor planning and poor management on the specific job in question.

When a bookkeeping system is being planned for a new business or the methods of an established business are being "revamped" it is most important to study the present and possible future needs of the business and thereby gain a thorough knowledge of just what the bookkeeping plan is expected to do. After gaining this comprehensive understanding, the page sizes, the ruling on the pages, the number of books, the type of binders and other details can be made broad enough in their scope to provide all necessary information, yet conform to the doctrine of simplicity.

Allow for Expansion. "Take no thought of tomorrow," is not a good watchword to follow when designing a record system. Although elaborate, cumbersome methods are to be religiously avoided in the job welding industry, provisions should be made in any plan for moderate expansion, not only in volume of business done, but also for the addition of new departments of the business.

Possibly at a later date you may install automatic welding equipment, put in a machine shop or a sheet metal department. Usually, by allowing a few extra columns here or some additional pages there these expansions can be provided for and no extra expenditure for books, cards or binders will be required when the addition is actually made. In most cases the sum total of expense is less if some provisions for enlargements are made when the bookkeeping system is installed than to be compelled to scrap the old plan and put in an entire new one later.

Avoid "Home Made" Systems. No job welder attempts to make his own welding torches, build his own electric machines or construct his own motor truck. By the same token he should not attempt to have an entirely "home made" bookkeeping system. From all sides we have it forced upon us that this is an age of specialization, requiring one man to make his living by laying bricks, another by hanging wall paper, third by practicing real estate law, etc. Under such a scheme of things it is not likely that one man can be both lawyer and paper hanger, welder and book maker, etc. Many pitfalls and costly blunders will be avoided if the shop manager gets some first class help to install his accounting system.

Study Other People's Methods. Some very helpful ideas may be obtained from systems now in use by other business houses. If you are careful to use the right approach and the proper degree of tact, the managers of most any noncompeting concern in your community will grant you the privilege of looking over their books to see how they handle the various operations. From the accounting systems used by a grocery store, a garage or a foundry you can get some worth while ideas which you can incorporate into your own system to good advantage.

Your Stationery Store Will Help You. Another excellent source of information relative to bookkeeping, records and accounting methods of all sorts is your local stationery store or dealer in office supplies and equipment. It is the business of merchants of this kind to have a broad knowledge of office systems which are used by commercial houses of various kinds and to keep up with the latest developments in the way of time saving apparatus and simplified practice. If they do not have in stock the books, cards and machines of all important types they have profusely illustrated catalogs which tell the story clearly and simply. In going to an office supply store for information you are not putting yourself under obligation to buy. It is a part of the job of such a store to give out information and you can get considerable benefit from what it has to offer.

Providing for Income Tax. It is highly important that whatever accounting plan you adopt be designed to provide with a minimum amount of effort the data required by the income tax laws. If you are not already familiar with these requirements you will do well to find them out from your local banker, justice of the peace, tax collector or someone else thoroughly familiar with this subject. Much time will be saved by planning a system to provide this information rather than going through an expensive,

laborious process each time a tax return must be submitted.

Making a Monthly Check Up

Our grandfathers checked up their affairs once a year—seldom oftener. But with all due respect to our elders, their plan of accounting has no more usefulness today than their one horse shays and their scythes and cradles. The modern business must know what it has done every month—the gross sales made, the profit earned and the approximate net worth of the establishment. Today, conditions change so rapidly and competition is so beastly keen that a business could go broke almost without knowing it if annual checkups were relied upon.

The Balance Sheet. One of the statements modern business houses—be they large or small—make out once a month is the balance sheet, sometimes called the statement of assets and liabilities. This statement is a summary of "just how the business stands," what it owns and what it owes, how much it has "on the shelf" or how much it is "in the hole." Naturally the items in a balance sheet vary with the kind of work and with the individual company. The following specimen is not intended to be complete or ideal but is fairly typical of a small job welding shop.

BALANCE SHEET OF BROWN WELDING CO. AS OF MARCH 31, 1932

ASSETS

Current assets:		
Cash in bank		$ 733.19
Accounts receivable, less a reserve for doubtful accounts		918.37
Shop supplies on hand—welding rods, gas fluxes, etc		265.22
Office supplies on hand—envelopes, paper, etc		53.00
Capital assets:		
Motor truck—cost less depreciation		543.26
Electric welding outfit depreciation		986.76
Gas welding and cutting equipment, torches, gas regulators, etc.		301.89
Miscellaneous equipment—eye shields, goggles, electrode holders, etc		67.19
Office equipment—desks, chairs, adding machines, filing cases, etc.		123.06
Deferred charges:		
Unexpired insurance, interest prepaid on borrowed money		43.15
Total assets		$4,035.03

LIABILITIES

Accounts payable	$ 412.98
Note payable at bank	660.00
Original investment in the business	2,400.00
Surplus and unused profits	562.05
Total liabilities	$4,035.03

Profit and Loss Statement. The second of the two principal statements, which is almost indispensable to any modern organization, is the profit and loss statement. As its name indicates, it tells at a glance whether the company has made a profit or a loss during the period it covers. It shows the total sales made on one hand and the total expenses on the other. It presents the net results of the operation of the business. The profit and loss statement given below is intended to show the general form only and is not intended to be ideal.

PROFIT AND LOSS STATEMENT OF BROWN WELDING CO. AS OF MARCH, 1932

Total value of all jobs completed during the month—the total amount received from or charged to customers		$762.34
Deduct from value of jobs:		
Cost of rods, gas and other supplies used	$ 43.00	
Salary of shop owner	140.00	
Wages of assistant welder	100.00	
Part time office help	50.00	
Gasoline and oil for truck	13.63	
Telephone	8.00	
Electric current and heat	30.10	
Postage and stationery used	15.09	
Interest on investment in equipment	16.13	
Rent	100.00	
Direct mail advertising	57.35	
Depreciation on equipment	48.00	
		$621.30
Profit for the month		$141.04

The central purpose of any accounting system, balance sheet, profit and loss statement, or any similar report is to enable the management to know the true state of affairs of its business. Does the company have a surplus or is it "in the red"? Did it make or lose money last year? Last month? Are the sales higher or lower than last year? Are the expenses too high? If so, what items make up the most of the total? These and similar questions can be quickly answered by a simple but sound bookkeeping plan. *Know the facts about the financial affairs of your business; to "kid yourself" is dangerous.*

A. W. S. Program Features

Research and Applications

The annual meeting of the American Welding Society will be held in the Engineering Society's Building, 33 West 39th St., New York, on April 27, 28, 29. Following is the program of meetings and papers which has been arranged:

WEDNESDAY, APRIL 27

Morning

Business and Technical Sessions

10:00 A.M. to 10:30 A.M. Room 2, 5th Floor, Business Meeting, E. A. Doyle, President, presiding.

10:30 A.M. to 12 Noon. Room 2, 5th Floor Technical Session, E. R. Ewertz, Past President, presiding.

Shipbuilding

"Welding in the Construction of U.S.S. New Orleans," by Captain J. O. Gawne, United States Navy.

"Experimental Determination of Stresses in Fillet Welds," by L. C. Bibber, Bureau of Construction and Repair, Navy Department.

"Welded Barge Construction," by Gordon G. Holbrook, General Superintendent, Federal Shipbuilding and Dry Dock Company.

Afternoon

Technical Session

2:00 P.M. to 5:00 P.M. Room 2, 5th Floor, F. P. McKibben, Senior Vice President, presiding.

"A Study of the Transformation Points of Fusion Weld Metal," by E. R. Hensel and E. I. Larsen, Research Laboratories, Westinghouse Electric & Mfg. Company.

"Cause and Cure of Intercrystalline Corrosion in Austenitic Steels," by John A. Mathews, Vice-President, Crucible Steel Company of America.

"Welding Duralumin," by H. S. George, Research Engineer, Union Carbide & Carbon Research Labs.

"Welding Wrought Iron Pipe," by James Aston, A. M. Byers & Company.

Evening

6:30 P. M. Dinner Meeting, Board of Directors.

Meeting of Board of Directors of American Welding Society. Appointment of Committee Chairmen and other Officers. Committee Reports. Plans for coming year.

THURSDAY, APRIL 28

Morning

Technical Session

9:30 A.M. to 12 Noon. Room 2, 5th Floor, C. W. Obert, Chairman, Welding Conference Committee, presiding.

"Spot Welding," by Carl De Ganahl, President, Fleetwings, Inc.

"Arc, Gas and Resistance Welding of Pressure Vessels," by H. LeR. Whitney, M. W. Kellogg Company.

"Production Welding of Light Gage Metal Specialties," by representative of Servel Company.

"Welding of Extruded Metal," by I. T. Hook, Research Engineer, The American Brass Company.

Afternoon

Technical Session

SYMPOSIUM "DUCTILITY IN WELDS"

2:00 P.M. to 5:00 P.M. Room 2, 5th Floor, F. T. Llewellyn, Past President, presiding.

Papers by C. A. Adams, Harvard University; E. Chapman, Lukenweld, Incorporated; E. R. Fish, Hartford Steam Boiler Insp. & Ins. Co.; T. W. Greene, The Linde Air Products Co.; C. J. Holslag, Electric Arc Cutting & Welding Company; C. H. Jennings, Westinghouse Electric & Mfg. Co.; H. F. Moore, University of Illinois; D. Rosenthal, University of Brussels; C. L. Waddell, Worthington Pump & Machinery Corp.

Evening

Eleventh Annual Dinner

6:30 P.M.

The Dinner will be arranged as a stag affair. An unusual educational and entertaining program has been provided. Price, $4.00. Hotel New Yorker.

FRIDAY, APRIL 29

Morning

Technical Session

9:00 A.M. to 12 Noon. Room 2, 5th Floor, J. J. Crowe, Director, American Welding Society, presiding.

"Modern Spot and Relief Welding," by P. W. Fassler, Manager, Electrical Welding Division, Fisher Body Corporation.

"Machine Gas Welding," by J. L. Anderson, Air Reduction Company.

"Pipe Welding for a High Pressure Steam Power Plant," by E. B. Severs and W. P. Garit, United Engineers and Constructors, Inc.

"New Aspects in Pipe Welding," by W. P. Curley, N. Y. District Manager, Tube Turns, Inc.

Afternoon

Meetings of

Structural Steel Welding Committee

American Bureau of Welding

2:00 P.M. to 3:00 P.M. Room 2, 5th Floor, Meeting of Structural Steel Welding Committee. L. S. Moisseiff, Chairman, presiding.

Outline of program of future investigations.

3:00 P.M. to 5:00 P.M. Room 3, 5th Floor, Meeting of American Bureau of Welding. C. A. Adams, Director, presiding.

Review of progress. Election of Officers. Plans for the coming year. Special report of Fundamental Research Committee.

Program Nearly Complete for Southwide Welding Conference

Preliminary work on the first Southwide Welding Conference, which is to be held at Alabama Polytechnic Institute, Auburn, Ala., May 23rd to 28th, has gone forward rapidly under the direction of Prof. D. T. Jones, head of Industrial Engineering and Shops. Due to the rapidly growing industrial activity in the southern district, there has been considerable enthusiasm shown for this important meeting, and it has been possible to arrange for lectures, demonstrations and exhibits by firms from all over the country. The

Shop Building at Alabama Polytechnic Institute Where Demonstrations and Exhibits Will Be Held.

officials of Alabama Polytechnic Institute are doing everything possible to provide for the comfort and convenience of visitors, and several prominent members of the faculty will appear on the program. There will be addresses by Pres. Bradford Knapp, Dean J. J. Wilmore and Prof. C. R. Hixon. A program of papers presented by men in the welding industry include the following:

"State Safety Codes and Regulations on Welding"—U. S. Dept. of Commerce.

"Welding for Profit"—H. S. Card, The Welding Engineer, Chicago, Ill.

"Manganese Steel Welding"—A. W. Daniels, American Manganese Steel Co., Chicago, Ill.

"Welding Overland Piping"—W. M. Rierson, Linde Air Products Co., Birmingham, Ala.

"Stellite"—E. E. Levan, Haynes Stellite Co., Kokomo, Ind.

"Hand and Automatic Welding in Production"—W. R. Campbell, Servel, Inc., Evansville, Indiana.

"Ten Methods of Testing Welds"—J. J. Crowe, Air Reduction Sales Co., New York, N. Y.

"Tip Sizes, Pressures and Speeds for Welding and Cutting Under Different Conditions"—Torchweld Equipment Co., Chicago, Ill.

"Job Welding"—Birmingham Welding Co., Birmingham, Ala.

"Plate Fabrication"—H. C. Boardman, Chicago Bridge & Iron Co., Chicago, Ill.

"Gas and Arc Welding of Copper and Its Alloys"—I. T. Hook, American Brass Co., Ansonia, Conn.

"Discussion on Welding Research"—C. A. McCune, Welding Engineering & Research Corporation, New York, N. Y.

"Under Water Cutting"—Craftsweld Equipment Co., New York, N. Y.

"Bronze Welding of Cast Iron"—S. H. Jones, Burdett Oxygen Co., Chicago, Ill.

"Methods of Determining Economical Types of Welding"—H. O. Westendarp, General Electric Co., Cleveland, Ohio.

"Resistance Welding for Assembly Stampings, Forgings and Sheet Metal Articles—Modern Practice"—M. L. Eckman, Federal Machine & Welder Co., Warren, Ohio.

"Pressure Vessel Welding"—Hedges-Walsh-Weidner Co., Chattanooga, Tenn.

"Possibilities Offered to Young Graduate Engineers in the Welding Industry"—L. C. Monroe, Steel Publications, Inc., Pittsburgh, Pa.

"Shielded Arc Welding"—J. F. Lincoln, Lincoln Electric Co., Cleveland, Ohio.

"Magnetic Inspection of Welds"—W. W. Reddie, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

"Metallography of Metals"—Prof. C. R. Hixon, Alabama Polytechnic Institute, Auburn, Ala.

"Metallizing, An Aid to the Welding Industry"—L. E. Kunkler, Pres., Metallizing Co., Los Angeles, Cal.

"Building Pipe"—Frank Lane, Bastian-Blessing Co., Chicago, Ill.

"Railroad Welding"—Morrison Railway Supply Co., Chicago, Ill.

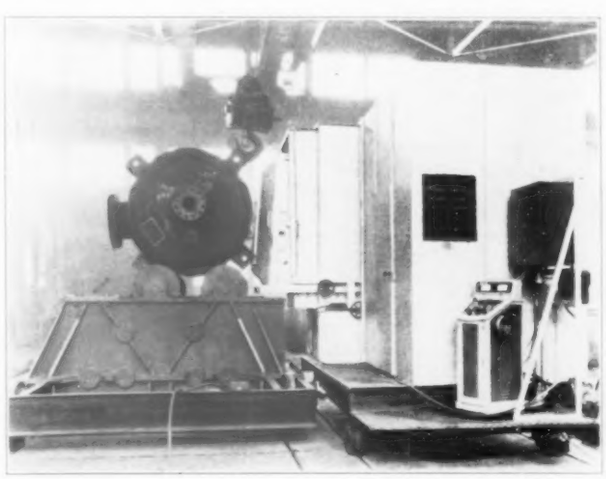
"Special Fittings for Pipe Welding"—H. A. Middleton, Crane Company, Birmingham, Ala.

"Lead Burning"—Speaker to be announced.

Advance notices of the conference indicate that accommodations for room and board are ample and that the rates are very moderate. Special demonstrations have been arranged for cutting cast iron and steel, aluminum welding, atomic hydrogen welding, cast iron welding, steel brazing, resistance welding, pipe welding, hard facing, thermit welding and metal spraying, and other demonstrations are contemplated. These demonstrations will all be held in the Engineering Shops.

Sun Shipbuilding and Dry Dock Co. Has X-Ray Installation

The X-Ray Installation recently built at Chester, Pa., by St. John X-Ray Service Corp., New York City, is notable for its convenience and flexibility. While it is designed primarily for routine examination of welded seams in pressure vessels according to the requirements of the A. S. M. E. Boiler Code it can be used with equal facility for the inspection of castings and other objects.



A. I. S. C. Will Study Steel Homes

Recognizing the growing tendency of builders throughout the country to make greater use of steel in residence construction, and believing that an exchange of views on this subject will be mutually helpful, the American Institute of Steel Construction is calling a conference in the Auditorium of the Engineers Society Building, 29 W. 39th Street, New York City, on May 24th and 25th, for the purpose of exchanging the very latest data and theories on residence construction. A program will be arranged to present the problem from the point of view of the mill, the engineer, the architect, the builder and the financier. If possible, provision will be made so that builders may present their individual ideas as to how a house should be built with the use of steel. The leading rolling mills have already promised to cooperate in this conference, and the A. I. S. C. is desirous of enlisting the support of all persons who may be interested.

National Safety Council Extends Its Service

On the sound and praiseworthy theory that every industrial concern is entitled to the benefits of organized accident prevention, the National Safety Council, 20 N. Wacker Drive, Chicago, has just announced a practical plan for spreading the gospel of industrial safety throughout the country. Under this plan, every company, large or small, regardless of whether it holds membership in the Council, can have that organization's help in establishing a definite working plan for a continuous campaign of accident prevention. In a recent communication, the National Safety Council advised that it stands ready to help any reader of *The Welding Engineer* in laying out a practical working plan for handling accident problems.

Chicago Welders Have Their Work X-Rayed

The April meeting of the American Welding Society, Chicago Section, which was held on the evening of April 1st, at the Palmer House, was devoted to a discussion of X-ray pictures taken of welded coupons prepared by welders in the Chicago district. The welds were made in coupons 6 inches long, cut from ⅜ inch plate, the coupons being submitted for X-ray inspection with one-half the length of the weld bead ground off flush with the plate. About 30 such coupons were X-rayed at the laboratory of the Claud S. Gordon Company, Chicago, this service being furnished to the Chicago Section without charge. After the X-ray photographs were taken, the coupons were sent to the Engineering Department of the Chicago Bridge & Iron Works, where specimens for nick-break tests and free bend tests were taken from each coupon and the nick-break and bend tests made. This work was contributed without charge by the Chicago Bridge & Iron Works. The remainder of the coupons, together with the nick-break and bend specimens, were brought to the meeting for examination. Each welder contributing a coupon to the program was furnished with a print of the X-ray picture of his coupon. All of the radiographs were displayed on an illuminated board at the meeting, and Mr. Claud S. Gordon, president of the Claud S. Gordon Company, went through the entire series, one at a time, pointing out such defects as were located by the X-rays and calling attention to such important defects as lack of penetration, gas pockets, slag inclusions and lack of fusion along one edge of the weld.

Shawinigan Industries Featured in News Story

In the April issue of *Compressed Air Magazine*, an article by W. M. Goodwin on St. Maurice River Power includes some beautiful views and interesting information concerning the plant of Shawinigan Chemicals, Ltd., at Shawinigan Falls. It is pointed out that while much of the carbide made at this plant finds its way into the oxy-acetylene industry, there is also a great deal of it diverted to chemical uses. A part of the equipment here is a huge acetylene generating plant from which acetylene is constantly flowing through large pipe lines to the adjacent chemical plants. An off-shoot from the chemical plant is the Shawinigan Stainless Steel and Alloys, a subsidiary founded two years ago. In this plant are manufactured vessels which are required to withstand the corrosive action of acetic acid and other chemicals.

Mexican Agent Appointed by Lincoln

La Consolidada, S. A., of Mexico, D. F., one of the largest steel manufacturers in Mexico and advocates of arc welding in that republic, have been appointed Mexican distributors by The Lincoln Electric Co., Cleveland, Ohio, manufacturers of "Stable Arc" welders and supplies, as well as "Linc-Weld" motors.

La Consolidada, S. A., is one of the best known steel companies in Mexico, and have added the sale of arc welding equipment to their other interests.

This company was established in 1900 as a branch of the Isaac Joseph Iron Co., of Cincinnati. The present company was organized in 1907. Max Wright is sales manager. The plant covers 16 acres and represents an investment of $3,000,000.

Hollup Establishes a New Branch in California

Announcement has been received that the Hollup Corporation, Chicago, Illinois, are opening up a new western factory at Emeryville, Calif. The new factory will manufacture a complete line of welding wire and will handle a complete line of welding machines and accessories. E. J. Schuler will be the manager of the western plant, with headquarters at Emeryville.

Welding in the Shipyard Presented at Philadelphia Section, A.W.S. Meeting

"Welding Problems in a Shipyard," a presentation by Mr. Harry Pierce, Welding Supervisor, New York Shipbuilding Co., featured the meeting of the Philadelphia Section of the American Welding Society, held on March 21.

"Inspection of Welded Steel Framing in Building," is scheduled for presentation at the April 18th meeting by Mr. F. Eder, of the New York office of Robert W. Hunt Co.

The April meeting of the Philadelphia Section is the annual meeting and new officers will be elected and installed at that time.

Ironsmiths and Welders Re-Elect Officers at South Bend

All officers of the Indiana Ironsmiths and Welders Association were re-elected at a meeting which was held at the La Salle Hotel, South Bend, Indiana, on April 5th and 6th. A. C. Harrington of Monon, Ind., was elected president; George Hoeckele of Elkhart, Ind., vice president and Wm. J. Volpert of Peru, Ind., secretary-treasurer. Numerous papers on welding subjects were read at the meeting and a series of welding demonstrations was held in the shops of Wm. Shaffer, 816 S. Main Street, South Bend. Nearly one hundred members and guests attended the convention. It was decided to hold the 1933 convention at Purdue University.

Information About Testing Machines Now Available

Bulletin No. 28, recently published by the Baldwin-Southwark Corporation, Philadelphia, Penn., contains 36 pages of data and illustrations of the line of Southwark-Emery testing machines. The bulletin has been prepared with the intention of doing a little more than merely describing this line of machines. It is stated, in fact, that it was published to have it constitute a short text book about testing machines. The text deals not only with some of the largest machines which have ever been constructed for test work, but also smaller outfits for the use of small laboratories.

Book Review: Manual of Electric Arc Welding

The Manual of Electric Arc Welding by E. H. Hubert has just been published by the McGraw-Hill Book Company, 370 Seventh Avenue, New York City. This manual has been prepared to present the main facts concerning electric arc welding and should prove valuable to welding operators and to engineers, designers and executives who are interested in the use of the process. The information has been drawn from many sources including principally the member companies of the Welding Equipment Section of the National Electric Manufacturers Association, under whose direction the manual was prepared. The introductory chapters present the fundamentals of arc welding and a discus-

sion of the equipment and accessories necessary in a modern layout. There is a simple and effective treatment of expansion and contraction followed by discussions of various joint designs. Then preliminary information is given on the actual making of welds in steel and special metals. The variety of application is covered mostly by illustrations of actual jobs. The book concludes with a complete detailed outline of a training course for operators, forty practice exercises being described and illustrated. The manual is a 160 page book bound in durable cloth binding. The price is $2.00 per copy.

Bulletin Describes the Uses of Sil-Fos

Handy & Harman, 57 William St., New York City, have just published Bulletin No. 7, which describes and illustrates the uses of Sil-Fos, a patented, low melting joint brazing alloy. This material is for use on copper, brass, bronze, extruded brass or bronze, nickel, nickel silver, monel metal and other non-ferrous metals and alloys. It has found practical application in the joining of copper tubing to brass shells, the joining of copper wire in ornamental fixtures, decorative metal work, large and small containers and tanks, joints in copper switches and a great number of similar applications. According to this bulletin Sil-Fos flows freely at 1300 degrees F. It penetrates quickly and produces a strong corrosion resisting joint.

Murex Publishing a Handbook for Electric Welders

Murex Welding Processes, Ltd., London, England, have published a new handbook for electric welders priced at one shilling per copy. It is stated that this small handbook has been written with the object of providing the welding operator and the user of arc welding with an elementary and concise account of the principles involved. The introductory portions discuss the relationship between heat and mechanical work, the characteristics of welding machines and elementary metallurgy of iron and steel. The beginners' instructions are brief and are followed by special instructions for different applications.

Stoody Bulletins Describe New Hard Facing Materials

New bulletins have recently been published by Stoody Company, Whittier, Calif., describing the improvements in their abrasion resisting materials. One bulletin is devoted to the new Shape Borium in which it is claimed the manufacturers have retained practically all of the hardness of the old type of Borium while increasing the toughness and resistance to breakage more than 500 per cent. It is stated that these new shapes will cut other metals at temperatures exceeding 3,000 degrees F., and that they are so tough that they can be used unsupported as lathe tools, etc., and in this respect will behave similar to cemented tungsten carbide tools and can be used as tips brazed into shanks. The new shapes do not crack or melt under the torch and do not alloy or disintegrate when in contact with molten steel. Another bulletin describes the various sizes of tube Borium and Borod. The latter product is recommended where a very smooth, thin layer of deposit is desirable, while the tube Borium is for coarser work. The circular indicates the sizes that are most popular for various specific applications.

"Machine Gas Cutting"

Under this title, the Air Reduction Sales Company, 60 E. 42nd Street, New York City, publishes a nicely printed 8-page booklet including a paper on "Machine Gas Cutting" which was read by M. L. Curtiss, of the Lukens Steel Company, before the 1931 Convention of the International Acetylene Association and a report on Mechanical Cutting included in the 1931 Oxy-Acetylene Committee Report of the I. A. A. This is supplemented by descriptions and illustrations of some of the latest types of mechanically controlled oxy-acetylene cutting torches.

Lincoln Bulletins on Machines and Structures

Recent bulletins of the Lincoln Electric Co., Cleveland, Ohio, include two instruction sheets on fabrication and structural work. Application Sheet No. 28 discusses and illustrates the application of bosses to levers, starting with very simple applications and developing designs which are a little more complex. Plate No. 33 of Studies in Structural Arc Welding is devoted to the subject of angle bracing in arc welded mill buildings. Angle braces are often preferred to rods, particularly for wall bracing. This well illustated bulletin shows a number of useful and practical designs.

Book Review: Practical Hints on Oxy-Acetylene Welding and Cutting

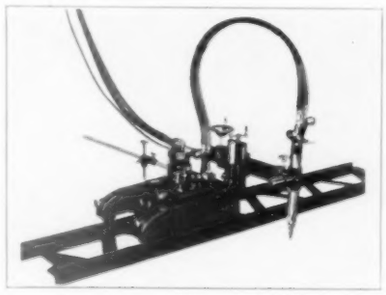
de l'Office Central de l'Acetylene et de la Soudure Autogene, 32 Boulevard de la Chapelle, Paris, has just published a new book on Oxy-Acetylene Welding and Cutting. This book fills a need which has not been met in previous volumes which were addressed more to the executive and engineer than to the operator and to the student. Practical instruction in welding procedure is presented in such a manner in the new book that it constitutes practically a series of lessons in gas welding. These are followed by 50 questions and practical problems with answers and 100 questions without answers. The book, which is printed in French, has 112 pages and about 100 illustrations. The price is 6 Francs per copy.

Linde Marketing a New Bronze Welding Rod

A new bronze welding rod, known as "Oxweld No. 25 M. Bronze Patented Welding Rod," has just been introduced by The Linde Air Products Co., 30 E. 42nd St., New York, N. Y. Because of special characteristics this improved manganese bronze rod is recommended for use in the rebuilding of wear-resisting surfaces such as piston rings or cylinder walls. Besides producing weld metal with wear-resisting qualities, this rod is said to have the added advantage of being non-fuming and free-flowing. The makers state that it is possible to remelt and reweld welds made with this welding rod with an ease heretofore considered impossible with a bronze welding rod. It is also effective for use in the sectional building up of large pieces, where the weld must be made in successive layers, because there is no heavy slag formed over the weld after it has cooled. One of its features is the hardness of the resulting weld. Welds made with it have consistently shown a hardness of 96 Brinell. This is a very important consideration when building-up wearing surfaces such as bushings or other abrasion areas. It is supplied in three sizes: 1/8 in., 5/32 in., and 1/4 in.

New No. 4 Radiagraph Announced by Air Reduction

The Air Reduction Sales Co., 60 E. 42nd St., New York City, has announced the new Airco-D-B No. 4 Radiagraph—an oxy-acetylene cutting machine, successor to the No. 1-A Radiagraph. The carriage of the machine has been completely redesigned with a lower center of gravity and a broader gauge. There is no tendency for the machine to become unbalanced, even with the torch in its outermost position. Two of the four



Redesigned Airco-D-B No. 4 Radiagraph

carriage wheels are swiveled and act as trailers. The clean surfaces of the machine, with a minimum of projecting parts, reduce the chance of serious damage in case of accident or rough handling. Wheels are almost completely shrouded for protection against oxides and dirt when cutting steel.

An improved variable speed motor of very rugged construction and approximately 75 watts rating provides the drive with practically constant torque at all speeds and maintains a nearly constant speed under conditions of fluctuating voltage and increasing temperature.

The motion of the motor is transmitted to the traction wheels by a double worm reduction and a simple type of clutch. All of the gearing and electric switches are enclosed in a dust-proof case. Gears are heavily lubricated with

grease which requires renewal only at rare intervals.

Three easily manipulated levers and a thumb screw, grouped near each other on the carriage comprise the complete control equipment for starting and stopping the motor, adjusting the speed, determining the direction of travel and connecting the motor to the traction wheels. A thumb plate is provided to permit actuating the levers without jarring the machine while cutting. The traction wheels are released from the motor drive by a simple movement of the clutch lever, allowing the carriage to be rolled along the track by hand.

The new machine can be supplied with or without tachometer to indicate the cutting speed in either direction. It is subsequently desired to add this equipment, installation can easily be made in the field.

By simple manipulation of the thumbscrew on the speed governor, the carriage may be made to travel through an uninterrupted speed range of from 3 inches to 28 inches per minute. Speed may be altered during the progress of the cut without breaking the cut or continuity of travel.

Sturdy handles are cast integral with the carriage at the front and rear, for lifting and carrying the machine, which weighs approximately 70 pounds, including the torch adjustment arm and torch.

Circular as well as straight cuts are made by the No. 4 Radiagraph with equal efficiency. A 36-inch radius rod is part of the standard equipment supplied and attaches to the machine through a hole extending entirely across the carriage and is held in position by two wing thumb screws. The radius rod may be made to extend from either side of the machine making it readily adaptable to different set-up conditions. Circles of from 4 inches to 80 inches in diameter may be cut with the 36-inch radius rod and center point provided.

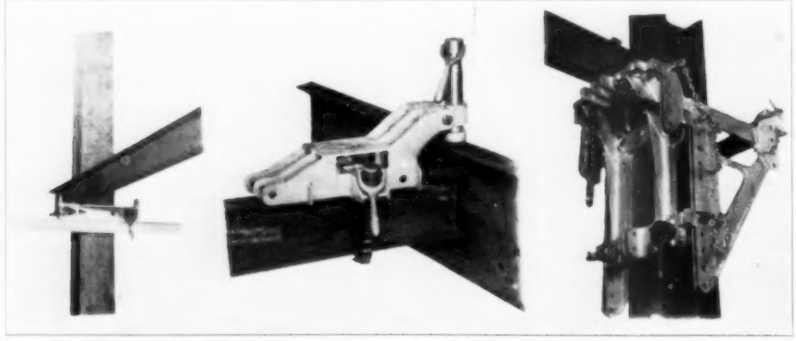
In order to assure a fixed amount of slack in the hose for torch adjustment and to prevent the drag of the hose from disturbing the torch setting as well as to hold the hose and extension cord clear of the operating controls, a special support bracket is mounted opposite the post which holds the torch adjusting arm. This bracket is removable. The plug and socket connecting the extension cord to the machine are of the locking type to prevent accidental disconnection.

The track consists of a specially constructed light 8-inch I-beam. The edges of the beam flanges constitute the rails of the track and, because of this shape, there is no possibility for scale and dirt to accumulate on them. They afford a clean, smooth surface for the carriage wheels. The stiffness of the track resists deflection under the weight of the machine. Continuous support under it is unnecessary. Lightness of weight with no appreciable sacrifice of stiffness is obtained by cutting away part of the web of the beam in a uniform pattern. Tracks are available in two lengths, one for straight line cuts up to 5-feet long and the other for cuts up to 8-feet long. Two lengths may be jointed and progressively laid, one length ahead of the other, for making cuts of any required length. The ends of the track are accurately machined so that, if properly interfitted, a close, firm and exactly aligned joint will result.

The No. 4 Radiagraph is specially adapted to straight line and circular cutting of steel of almost any size and thickness. Contours comprising combinations of straight lines and arcs are also cut efficiently with this machine.

New Line of Assembly Clamps Now Available

The Tack Weld Clamp Co., 1065 Atlantic Avenue, Brooklyn, N. Y., has started the production of a complete line of clamps for use in connection with structural assemblies, piping and similar types of work which have to be tack welded securely in place before welding is started. There is a scaffolding clamp having a variable width capacity which is used in combination with a column clamp for supporting beams and channels and other shapes for cutting or welding. There is also an adjustable floor beam clamp with several attachments which can be used for general bridge work and a column clamp having a height adjustment which can be used either for making assemblies in the field or in connection with cutting down old steel structures. A universal tack weld clamp for pipe work is made in three sizes, the first taking pipe from 1 in. to 6 in., the second from 2 in. to 12 in., and the third from 4 to 30 in. This clamp will protract longitudinally or transversely to support flanges, couplings, reducers and bends, and provide sufficient space for cutting openings. The accompanying illustrations show three types of clamps for structural work and the tack weld clamp for pipe work. Patent application has been made for the complete series and the designs copyrighted. The illustrations used here are reproduced by special permission of the manufacturers.



Left: Scaffold Clamp. Center: Adjustable Floor Beam Clamp. Right: Column Clamp.

Tack Weld Clamp for Pipe Work.

New Carbon Commutator Brush Announced by National Carbon

National Carbon Company, Inc., Carbon Sales Division, Cleveland, Ohio, has recently announced a new electrographitic brush known as National Pyramid Grade No. 234, the unique characteristic of which is a non-resilient structure—a property which enables the brush to maintain exceptionally firm contact on commutators of high peripheral speed. It is announced that excellent commutation, low friction and high carrying capacity combine with the smooth riding properties of this new grade to minimize brush wear and commutator maintenance. The field of application of this new grade as stated in the announcement is for heavy duty direct current generating and substation equipment.

New Lincoln Welding Head for Automatic Work

A wire feeding head which allows automatic arc welding with the shielded arc process has been developed by The Lincoln Electric Co., of Cleveland, Ohio.

The result claimed for this head is very high speed operation on either butt, fillet or building up welding, the deposited metal having physical characteristics equal to or better than mild steel.

The shielded arc technique is secured through the use of the Electronic Tornado welding head and a fibrous autogenizer which is fed into the arc flame. This autogenizer burns and forms a gas excluding the oxygen and nitrogen of the atmosphere while the metal is molten. The welding head utilizes a carbon arc around which is superimposed a magnetic field which directs the arc stream on the line of fusion.

Full automatic control of the arc is obtained thus maintaining the heat of the arc constant. Means are also provided for varying speed of the travel of the head through a wide range.

Continuous filler metal is obtained

from a reel mounted on the head and fed into the arc just in front of the arc travel. Means are provided for varying the rate at which the filler metal is fed into the arc so that the amount of metal deposited can be varied to meet the conditions demanded by the speed of the head and the type of weld being made. Since the rate at which the filler can be fed is varied independent of the speed of the head travel, only one size of filler metal is necessary for any type of work within the range of the machine. The filler metal is usually in strip form to insure greater accuracy in feeding the metal in the arc.

The only factors determining the most desirable size and form of the filler metal are ease of handling, compactness of the coils and minimum disturbance of the arc. In view of these factors filler strip $\frac{3}{16}$ inch wide and $\frac{1}{8}$ inch thick has been adopted as standard and is furnished in 70 pound coils 12 inch I. D. and about 18 inch O. D., and $3\frac{1}{4}$ inch traverse. These coils are securely tied and treated to prevent corrosion during storage. When being used the coil of

New Lincoln Automatic Welding Head.

filler is mounted on a steel reel with detachable head furnished with each automatic.

It is claimed that the use of this automatic brings several important improvements to welding. Namely—

1. The filler metal carries no current and its size is independent of the current used for welding. One size of strip can be used for any current from 75 to 500 amperes.

2. As the filler does not carry current, spatter and waste is largely eliminated.

3. The filler strip does not pass through the arc as in metallic welding, but beneath it, and is therefore not subject to the extremely high temperature of the arc stream.

4. It makes possible a practical method of shielded arc welding where it is desirable or necessary to add filler metal.

Since the welds are made in a shielded arc, the physical characteristics are similar to those obtained by other shielded arc methods. It is claimed a tensile strength ranging from 65,000 to 80,000 pounds per square inch is obtained with a ductility of 20 per cent or more elongation in 2 inch. It is also claimed that a resistance to corrosion better than mild steel is obtained.

The manufacturer states that the range of applications of this type of automatic covers practically all fields where arc welding is applicable.

New Metal-Cutting Saw Uses Heat of Arc

Announcement has been received of an unusual application of the electric arc for cutting, developed by the Electric Arc Cutting & Welding Company, Newark, N. J. The equipment consists of a disc operating very much after the manner of a circular saw but carrying a low voltage, high amperage current. The current of several hundred amperes flowing between the wheel and the work of course sets up a melting temperature and the revolving wheel gradually presses through the metal. It is stated that the work is melted and eaten away rapidly and that the process can be applied to some types of alloys in addition to mild steel.

New Quick Acting "C" Clamp and Drill Press Vice

The Climax Equipment Co., 5514 W. Lake St., Chicago, Ill., are now offering a quick acting square "C" clamp called the "Flash." One of the uses of this new clamp is a drill press vice as well as for ordinary clamping purposes.

The "Flash" is simple to operate and heavily constructed to withstand all the strenuous work that is required of it. Operation of the "Flash" is simplified by a one handle or cam control.

When it is desired to bring the jaws of the clamp in contact with the material, the upper sliding jaw is released from the upright member, by moving the handle in a counter clockwise direction. When the material is held between the jaws, the handle is then turned in the opposite direction, to increase the pressure. This movement binds the upper jaw to the upright, and forces an auxiliary jaw out to take up all play and hold the material rigidly

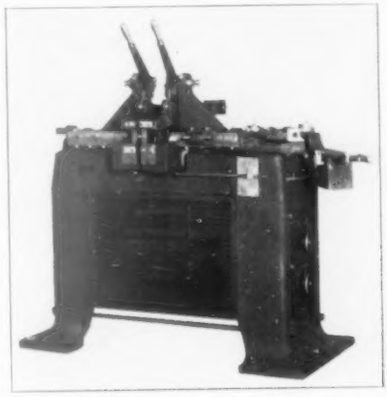
"Flash" Clamp Permits Fastening Work Quickly.

in place. The auxiliary jaw is designed in such a manner as to accommodate all the excess pressure. When the handle is in its normal position, the upper jaw will not slide along the upright.

Perfect performance is claimed because of the rigid construction of the clamp. The upper and lower jaws are made of nickel cast iron. The lower jaw is held firmly to the upright, which is made of tool steel, by casting the jaw around it. "Flash" Clamps are available in various sizes. The standard sizes are made in 6 in., 12 in. and 18 in.

'Standard' Butt Welder Announced by Lenney

The Type B "Standard" Butt welder recently announced by The Lenney Machine & Mfg. Co., Warren, Ohio, were designed to meet the needs of manufacturers who require a light and medium stock capacity machine for production work. Substantial and properly



Lenney Type B "Standard" Butt Welder.

placed backup and spacing arms, easily adjustable, are furnished as standard equipment.

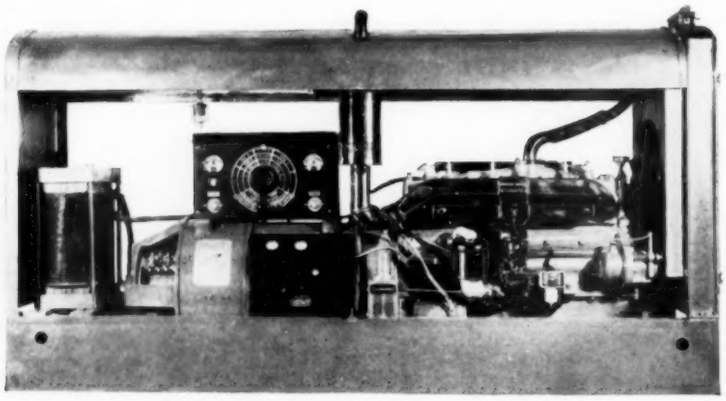
The welding lever on the hand operated machine carries a contact switch operated from a thumb latch, so that the current may be turned on or off at will by the operator during the welding cycle. Another switch is located inside the frame, operating from a trip on the sliding head. This switch automatically breaks the circuit at any predetermined point regardless of the switch on the push-up handle. The upset is by single toggle movement with die opening of 2 inch, and with a total adjustment between dies of $3\frac{1}{2}$ inches. The current regulation is in 12 steps giving both a wide range, and a fine current and voltage control.

Williams Issues New Price Schedule of Welding Supplies

Williams and Company, Pittsburgh, Penn., have recently issued a new price list presenting their entire line of gas and electric welding supplies. The new price list is much larger than previous issues and contains much useful information on the selection of items and on the technique of applying some of the special materials such as nickel, manganese rods, hard surfacing rods and aluminum. It is pointed out that a new department has been added to include head and eye protective equipment. Several pages cover this line. Another particularly interesting feature is a descriptive list of some twenty pamphlets on various welding subjects which are available without cost to the customer.

Hobart Announces a New Welder for Oil Field Work

400 amperes at 40 volts is the continuous service rating of the new type, 6-cylinder, self-starting, gasoline engine drive arc welder, specially developed to meet modern oil field requirements, by Hobart Bros. Co., Troy, Ohio.



Hobart Oil Field Welder with 400 Ampere, 40 Volt Rating.

The new machine is said to be finding great favor with experienced oil field operators who have, in the past, been depending upon equipment rated at 400 amperes, 25 volts, with engine speeded up to provide the extra capacity required for modern "Shielded Arc" welding which calls for 30 to 40 volts. This new oversize Hobart "Constant Arc" Welder is built in single unit with a heavy duty industrial engine, rated 66 H.P. at 1500 R.P.M. Equipped with special, supercooling system, it is claimed that this machine will handle the heaviest welding with largest size, heavy coated welding rods—without overheating and without shaking to pieces under the strain.

Gasoline consumption is conserved in two ways, either or both of which may be used by the operator at will, depending upon the type of work being done. First, the Hobart "Varispeed" regulator permits governing the engine down to lower continuous speed when operating at lower welding rates, thus substantially saving on fuel as well as on wear and tear throughout. In addition to this feature, this machine is also equipped with an electric idling device which can be cut in or out as desired. When in use, it allows 12 to 15 seconds for changing electrodes and, if the arc is broken for longer periods, it automatically slows the engine down to idling speed, bringing it up to full governed speed again instantly when the arc is restruck.

The new diverter pole type of generator is embodied in this machine, together with the triple range, "Unitrol" dial and the Navy Type, twin-coil, laminated-core reactance. The advantages claimed for this combination are a quick arc recovery, a tenacious arc, a stable arc even under an unsteady hand, less breaking of the arc, less sticking of the electrode and less splattering of molten metal.

New Metal Coating Tool Now on the Market

A new tool for applying a metal coating by means of spraying molten metal, called the Metalizer, has recently been announced by the Metallizing Company of Los Angeles, 1218 Long Beach Avenue, Los Angeles, Calif. The accompanying view shows the Metallizer being used to coat the inside of an acid-sludge truck tank with lead. The metal comes into the back of the spray gun in wire form from a spool and is shot out through the nozzle as a high molten spray under pressure. The tool will coat with zinc, nickel, lead, bronze, copper, monel metal, aluminum, brass or tin. The protective coating may be built up as thickly as desired. The fields of application are in rustproofing of construction work, marine work, chemical stuffs equipment, architectural work, etc. Complete outfit including connecting hoses, regulator and all parts sells for $500.00. The manufacturers have prepared a four-page bulletin illustrating some of the present applications and describing other possible applications of the process.

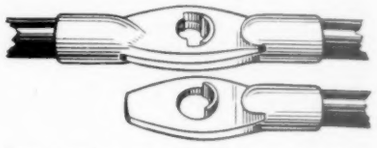
Applying a Lead Coating to a Sludge Tank with the Metallizer.

New English Publication Describes Oxy-Acetylene Process

The Acetylene and Welding Consulting Bureau, Ltd., 637 Grand Buildings, Trafalgar Square, London, has published a 20-page booklet entitled, "*Acetylene Flames*" for the purpose of acquainting the public with the possibilities of oxy-acetylene welding. It contains a short treatise on acetylene followed by an explanation of what oxy-acetylene welding is and how it is applied to various metals and various types of structures. In a section devoted to the economies of pipe welding there are presented a couple of charts showing how rapidly the cost of fitted joints rises with an increase in the diameter of the pipe, as compared to the rise in cost of welded pipe connections.

Marketing a New Lug for Welding Cables

There has recently been put on the market by Major Works, 210 Jackson Ave., Des Moines, Iowa, a new lug especially designed for use with welding cables. The lug is made in one size which is recessed to receive No. 2 to No. 2-0 cables. They are all alike so that there is no inconvenience of hunting for special mates. Any two lugs may be linked instantly in a secure electrical junction, and may be instantly released, since no bolts are used. Complete instructions for securing the lugs to the cables are furnished. A special shield of durable fabric is also supplied for the purpose of covering the junction and protecting it.



New Lug for Welding Cable Connections.

News of the Industry

Shawinigan Products Corporation, formerly located at 110 William St., New York City, moved its office to the Empire State Building on April 15th.

P. R. Mallory, Inc., Indianapolis, Ind., announce the appointment of A. O. Braun, 1528 W. Adams St., Chicago, Ill., in charge of territorial welding sales for the Chicago district.

W. S. Cannon, of the Henry Vogt Machine Co., Louisville, Kentucky, extensive manufacturers of welded oil field and refining equipment of various kinds, recently made a business trip to the Pacific Coast. While in Los Angeles, Mr. Cannon attended the Third Annual California Oil Equipment & Engineering Exposition which was held there March 21st to 27th inclusive.

Williams Brothers, pipe line contractors of Tulsa, Oklahoma, were recently awarded a contract for the welding of an 18-mile, 10-inch gas pipe line for the Panhandle-Eastern Company's line from Hannibal, Mo., to Quincy, Ill. The contract also calls for the welding and laying of approximately 10,000 feet of 8-inch river pipe.

J. S. Smith, engineer for Byron Jackson Co., of Los Angeles, Cal., manufacturers of welded oil field equipment, recently made a business trip for his company over the Rocky Mountain territory.

The break extended through half the bore of the the shaft bearing, detaching a piece of metal nearly a foot long.

The break prepared for welding.

When the weld was completed, the shaft bearing aligned perfectly.

This 2500-lb. casting was repair-welded with TOBIN BRONZE in three hours at a cost of $50

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding	
Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F
for arc welding	
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

THIS 2500-lb. cast iron power press frame fractured completely through the main bearing shaft. A new casting would have cost $500 and involved weeks of delay. An experienced welder recommended bronze welding as the least expensive, quickest and best method of restoring the press to service.

Preparation required about five hours. Actual welding was accomplished by one man in three hours and five minutes. A helper handled a heating torch which played continuously ahead of the weld. Twenty-two pounds of ¼" Tobin Bronze Welding Rods and 240 cu. ft. each of oxygen and acetylene were used. The *total* cost of the job was approximately $50, just 10% of the cost of a new casting.

The uniform high quality and unvarying dependability of Anaconda Copper Alloy Welding Rods are due to the experience and technical knowledge gained in developing a complete line of rods for bronze welding—gas and electric. Anaconda Welding Rods are available through leading distributors of welding supplies . . . usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. For complete information, ask for Anaconda Publication B-13.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities

ANACONDA WELDING RODS

FIRE AWAY!

Duraweld Goggles **fit snugly over the eyes. The left eye cup is individually designed for the left side of the face and nose, the right eye cup individually designed for the right side. Foreign particles—sparks and scale—can't get in.**

Noviweld Lenses **give your welders eye protection against dangerous ultra violet and infra-red rays and excess light. Through Noviweld the detail of the work is seen clearly and sharply.**

Duraweld Goggles **fitted with** ***Noviweld Lenses*** **give your welders' the best in eye protection. They can work all day, day after day, with eyes that are safe, comfortable and not strained.**

Duraweld is the goggle for your men!

J410

PATENTED

DURAWELD GOGGLES

SAFETY BRANCHES IN ALL PRINCIPAL CITIES

AMERICAN OPTICAL COMPANY

On account of retarded business activity, the Southwestern Welding Association with headquarters at North Texas Agricultural College has decided not to hold its annual conference this year. This decision does not discontinue the southwestern meetings indefinitely and it is planned that they will be resumed as soon as business conditions justify.

The March ordinary meeting of the Institution of Welding Engineers was held Thursday, the 17th, in the rooms of the Institution of Mechanical Engineers, Storey's Gate, St. James' Park, London. J. H. Patterson, D.Sc., F.I.C., presented an illustrated paper, "The Arc Welding of Structural Steel."

On March 9, the Hartford Section of the American Society of Mechanical Engineers had as its speaker J. R. Weaver, of the Westinghouse Electric & Mfg. Co., whose subject was "New Methods of Building Machine Tools by Arc Welding."

Everett Chapman, director of Engineering Research, Lukenweld, Inc., presented a paper, "Welded Industrial Equipment with Reference to Machine Tools," before a joint meeting of the Metropolitan and Plainfield Sections of the American Society of Mechanical Engineers in Newark, N. J., March 21.

A commercial welding department has been established by Northern Engineering Works, 210 Chene St., Detroit, Mich., which will include engineering, design and layout service in connection with the welding. They will specialize in the production of steel frames, bases, fabricated structures, gear housings, special machine parts, etc. Intricate shapes will also be available by mechanical torch cutting.

USL Battery Corp., Niagara Falls, N. Y., manufacturers of USL arc welders and accessories, have appointed W. J. Holliday Co., Indianapolis, Ind., distributors for their products in Indiana, Michigan and Illinois. The Virginia Welding Co., 116 Virginia St., Charleston, W. Va., will handle the line in that section of West Virginia. A portion of Illinois and Iowa has been alloted to the Moline Welding Co., Moline, Ill.

In a recent issue of Wire Engineering, publication of John A. Roebling's Sons Co., Trenton, N. J., an article describes the Mariposa, a new 25,000 ton liner recently placed in Pacific service. The article points out that considerable change in construction is to be seen in this new ocean greyhound as compared with that of other days. Riveting has given way to the newer method—welding. This new ship has over 60,000 lbs. of Roebling welding wire used in its fabrication.

William S. Wilbraham, who has been in charge of the Estimating and Order Dept. at Lukenweld, Inc., Coatesville, Pa., since this organization was established in 1929 to manufacture welded parts for machinery and equipment, has been appointed Assistant Manager of Sales, and will work directly with Henry H. Peck, Manager of Sales.

R. D. Thomas & Company, of Philadelphia, who specialize on electric spot welders, electric arc welders and all kinds of arc welding electrodes, announce the appointment of Mr. F. J. Giroux, 4712 190th Street, Flushing, New York, as their representative in New York and vicinity.

Chester Vorhees, operator of a leading automotive welding works at 1287 Westlake north, Seattle, Wash., is now welding starter teeth on flywheels by a new method, which is said to represent a savings of from 50 to 75 percent.

The Welding Service Shop, featuring general oil field service welding of all kinds, recently opened for business near 17th Street and Loma Avenue in Signal Hill, Cal. The new shop which is located in the rear of the O'Grady Machine Shop, is under the joint management of the partners, Frank Upham and Mark Hopkins. Until a short time ago they operated a welding service shop at Blackwell's Corner, situated in the North Belridge oil field, not far from Lost Hills.

M. J. Masel, who formerly was associated with the Mid-Continent Petroleum Corp., recently became connected with the Key Boiler & Equipment Co., Tulsa, Oklahoma, manufacturers of welded oil field tools, and also featuring general oil field welding service in the Mid-Continent area.

Some welding was used in the floor construction of a small two-story building recently constructed at the plant of the Porete Mfg. Co., North Arlington, N. J. An unusually light steel frame was used and was enclosed in poured light-weight concrete.

B. F. McIntyre is now connected with the Chicago office of the Lincoln Electric Co., manufacturers of "Linc-Weld" motors and "Stable-Arc" welders, in charge of motor sales for the Chicago district. Mr. McIntyre was formerly with the Industrial Controller Company, of Milwaukee. His electrical engineering education was obtained in Toronto, Canada.

A substantial interest in the Steelweld Machinery Company, Cleveland, has been purchased by the Cleveland Crane & Engineering Company, Wickliffe, Ohio. It is stated that the Steelweld concern will continue in business as a selling organization, all production being turned over to the Cleveland Crane & Engineering Company.

Mr. J. F. Mehlhope, formerly Chicago district sales manager for Central Alloy Steel Corp., and later for Newton Steel Co., has joined the sales force of the Chicago Steel Service Co., warehouse distributors for Toncan Iron and Enduro stainless steels, products of Republic Steel Corp.

William Gillespie and Lorn Rutledge have reopened the David M. Blythe blacksmith and welding shop at Irvington, Iowa, and will specialize in all kinds of repair work.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

FOR SALE

"Lincoln" 200 to 300 amp. gasoline powered portable welder mounted on trailer. Good condition in every way, used very little—$800.00. Full description and photograph on request. Snodgrass & Schaeffer, Inc., 2514 Bethel Avenue, Indianapolis, Ind.

Welding and Radiator Works in North Jersey, established 1914. A-1 location, shop and equipment; because of physical condition, owner offers fine opportunity to reliable party to acquire all or part interest. Terms arranged. Write stating experience, capability and age to "Opportunity," The Welding Engineer, 222 American Circle Bldg., New York City.

For Sale—$3,656.00 worth of equipment and stock. A well paying business established 12 years. You will want to know more about this offer, especially the cash price. Write the Electric Welding Works, 16 W. Haley St., Santa Barbara, Cal.

WELDING EQUIPMENT

Bargains—Arc welders, gasoline or electric drive. 30 days' trial. Terms if desired. Write Ken's Equipment Exchange, Box W-421, Troy, Ohio.

POSITIONS WANTED

Air Liquefaction Plant Engineer, manager and superintendent, thoroughly experienced in production of oxygen and nitrogen; electrolite production of oxygen and hydrogen; acetylene. Proven capability as manager and constructor of large industrial gas plants here and abroad; qualified to conduct plants on thoroughly economical basis and to provide for modern construction and improvements. Will consider connection in U. S. or S. America; excellent references; speak English, German, Spanish. Address Box 454, The Welding Engineer.

Combination Welder—Six years' experience both gas and arc welding; includes experimental work for large industrial on nickel, cast iron, manganese, monel, copper and other alloys. Know high-pressure boiler welding and pipe work. John C. Heflin, 1542 Wooster, Barberton, Ohio.

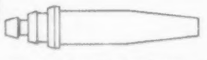
Two experienced welders desire positions on oil or gas line construction. Fourteen years' experience with both oxy-actylene and electric welding. Address Swen G. Anderson, 2200 Ashland Ave., Racine, Wis.

Welding Engineer—14 years' experience in job shop welding and training welders. Competent welder, draftsman and designer. Know acetylene, electric arc and resistance welding. Address Schrader, 6738 Woolston Rd., Philadelphia, Pa.

Former Chief Instructor for one of largest welding schools in America with wide experience in all types of welding. Can furnish equipment; prefer a small organization; excellent references. Address Box 455, The Welding Engineer.

SHURLITE TORCH LIGHTERS

We Manufacture
TORCH and GAS LIGHTERS; RENEWAL TIPS
Also Sparking Metal Alloys, all shapes and sizes
Write for Prices
G. C. FULLER MANUFACTURING COMPANY
Established 1917
605 Sycamore St., Cincinnati, Ohio

CUTTING and WELDING  TIPS for Torches

▼ STANDARDIZED cutting and welding tips, interchangeable with various types of torches; also apparatus, accessories and complete outfits—obtainable from one responsible source. Prices unbelievably low. High quality and workmanship.

Write NOW for complete Catalog
TIPS - INC.
515 Cathedral St. Baltimore, Maryland

Responsible Dealers Wanted

Competitive tests prove that the Smith-Waters Welder can save as much as 50% in welding operating costs. The stable arc assures constant deposition of weld metal. No moving parts. This machine is unconditionally guaranteed for two years.

Write for Proposition Giving Attractive Discount to Live Dealers

David H. Smith & Sons, Inc., 135—51 Street, Brooklyn, N. Y.

SMITH-WATERS WELDER

YOU CAN DO IT BETTER WITH TORCHWELD

Many misleading and depreciating statements about torches and regulators are being made. We have no desire to discredit anyone, but as manufacturers of such equipment we feel a responsibility to give users the true facts about Torchweld torch and regulator construction, quality and price.

If these facts discredit the products and statements of other manufacturers, there is nothing we can do about it. We do not desire to discredit their statements and claims, but we do feel a responsibility to call attention to the facts.

FOR

Value

USE

TORCHWELD

Non-Flash Equipment

"BUILT TO STAND THE ABUSE OF CONSTANT USE"

Write for our Blue "N" Gold Catalog and ask us for the name of our nearest Distributor to you.

TORCHWELD EQUIPMENT COMPANY, 224 N. Carpenter St., Chicago, Illinois

---

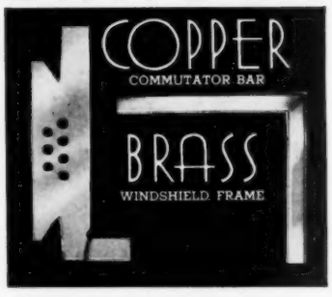
Weld

BY RESISTANCE METHOD
(SPOT or FLASH)

BRASS
COPPER
ALUMINUM
—and all other

NON-FERROUS METALS

Copper, brass, aluminum and other non-ferrous metals can be welded on Taylor-Winfield electric welders just as speedily, efficiently and economically as steel! If you have any welding problem peculiar to your product . . . ask a T-W Weldineer to help you!



THE TAYLOR-WINFIELD CORPORATION • Warren, Ohio
OFFICES IN PRINCIPAL CITIES

TAYLOR-WINFIELD
Creative WELDING SERVICE
SPOT - BUTT - PORTABLE - FLASH - SEAM

AMERICAN WELDING SOCIETY

A Cooperative Organization

. . . . of individuals interested in promoting knowledge of the art of welding and extending its applications through national and section meetings, promulgation of codes, standards, specifications, research work, technical reports and committee activities.

All those interested in welding should be members of the Society. Annual dues—Associate Members $10.00.

For full information regarding Society activities and what membership in this organization can do for you, write A. W. S. Headquarters at

33 West 39th St. New York, N. Y.